BULLETIN of the
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INDIANA UNIVERSITY

Indiana and Midwest School Building Planning Conference: Proceedings

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FOREWORD

Another year has passed, and with it the conclusion of another successful Indiana and Midwest School Building Planning Conference. Many of our guests have come from great distances, even as far away as Canada. It is gratifying that so many return year after year. We hope that more and more people will make attendance at this annual conference a habit and will feel free to make suggestions for the program.

This bulletin containing the proceedings should serve to refresh your memory of the conference and pinpoint some of the important facts. We hope it will prove valuable as reference material. A number of people inform us that they have bound their copies of the proceedings since the first summer conference in 1947.

Next summer we expect to have many surprise speakers on timely topics and important subjects. We hope to see you then.

PAUL W. SEAGERS
Conference Chairman

Program

1955

INDIANA AND MIDWEST SCHOOL BUILDING PLANNING CONFERENCE

THEME: *"Planning School Buildings Wisely"*

This conference is planned jointly with Margaret I. Rufsvold, Director, Division of Library Science, and L. C. Larson, Director, Audio-Visual Center, at Indiana University.

Exhibits are under the direction of John Alton Moldstad, Instructor and Research Associate in Audio-Visual Education.

PAUL W. SEAGERS, *Conference Chairman*

WENDELL W. WRIGHT, *Dean, School of Education*

SCHOOL OF EDUCATION INDIANA UNIVERSITY
BLOOMINGTON, INDIANA

THURSDAY AND FRIDAY
JULY 7-8, 1955

THURSDAY MORNING, JULY 7

School of Education—University School

9:00 a.m.

Registration—Lobby, University School

10:00 a.m.

Auditorium, University School

Chairman, William Chase

Welcome: Christian W. Jung

BETTER USE OF AUDIO-VISUAL INSTRUCTIONAL MATERIALS IN OUR SCHOOLS

Wilbur Young

General discussion: Audio-Visual Education and Its Implications For School Plants

11:00 a.m.

Time out to explore exhibits

THURSDAY AFTERNOON, JULY 7

1:30 p.m.

Auditorium, University School

Chairman: Wayne Weber

A SUCCESSFUL PLAN FOR THE ECONOMICAL AND EFFICIENT MAINTENANCE OF SCHOOL BUILDINGS

Ronald Brown

REHABILITATION OF SCHOOL BUILDINGS FOR AUDIO-VISUAL USE

E. Eugene Higgins

Discussion: From the Floor

THURSDAY EVENING, JULY 7

8:00 p.m.

Auditorium, University School

Chairman, Ruth G. Strickland

BRINGING THE WORLD TO THE CLASSROOM

Spencer W. Myers

FRIDAY MORNING, JULY 8

9:00 a.m.

Auditorium, University School

Chairman: Dale E. Brock

PLANNING BUILDINGS FOR INSTRUCTIONAL MATERIALS FROM THE VIEWPOINT OF:

THE ADMINISTRATOR—Paul W. Seagers

THE LIBRARIAN—Margaret I. Rufsvold

THE AUDIO-VISUAL SUPERVISOR—L. C. Larson

THE THEORY OF BALANCED ENVIRONMENT AND ITS RELATIONSHIP TO AUDIO-VISUAL EDUCATION

Darell B. Harmon

Discussion

FRIDAY AFTERNOON, JULY 8

1:30 p.m.

Auditorium, University School

Chairman: Clarence E. Stewart

BALANCING THE ENVIRONMENT FOR AUDIO-VISUAL EDUCATION

Light Control—Carl J. Allen

Sound Control—Hale J. Sabine

Thermal Control—Zephyrin A. Marsh

Discussion

WHO'S WHO AMONG THE SPEAKERS

ALLEN, CARL J., General Electric Lighting Institute, Nela Park, Cleveland, Ohio.

BROCK, DALE E., Superintendent of Schools, Connersville, Indiana.

BROWN, RONALD, Member of the Board of Education, Cleveland Heights, Ohio, and Vice President, Tremco Corporation.

CHASE, WILLIAM, Director of Schoolhouse Planning, Indiana State Department of Public Instruction, Indianapolis, Indiana.

HARMON, DARELL B., Consulting Educationalist, Austin, Texas.

HIGGINS, E. EUGENE, Director of Buildings and Grounds (on leave), Richmond, Virginia.

JUNG, CHRISTIAN W., Director of Summer Sessions, Indiana University.

LARSON, L. C., Director of Audio-Visual Education Center, Indiana University.

MARSH, ZEPHYRIN A., Director of School Activities, Minneapolis-Honeywell Regulator Co., Minneapolis, Minnesota.

MYERS, SPENCER W., Superintendent of Schools, Flint, Michigan.

RUFSVOLD, MARGARET I., Director of the Division of Library Science, Indiana University.

SABINE, HALE J., Celotex Corporation, Chicago, Illinois.

SEAGERS, PAUL W., School Building Planning Consultant, Professor of Education, Indiana University.

STEWART, CLARENCE E., Superintendent of Schools, Monroe County, Bloomington, Indiana.

STRICKLAND, RUTH G., Professor of Education, Indiana University.

WEBER, WAYNE, Architect, Terre Haute, Indiana.

YOUNG, WILBUR, State Superintendent of Public Instruction, Indianapolis, Indiana.

BETTER USE OF AUDIO-VISUAL INSTRUCTIONAL MATERIALS IN OUR SCHOOLS

Wilbur Young

It seems almost unnecessary to tell this group that there is a need for school buildings. Everyone knows it by now, for today it is impossible to pick up a newspaper without reading of the tremendous need for school buildings. Parents are complaining that their little Johnnies and Marys are going to school only half-days in many places. The situation has created so much public interest that radio and television stations have placed considerable emphasis on the problem. National magazines are devoting many pages to the issue, and even the President has called a national conference, with special interest being developed in the area of the building problem.

We in Indiana, however, are primarily interested in Indiana. In 1951 the Indiana General Assembly recognized the gravity of the situation by creating the State School Survey Commission. The main function of this commission was to make a statewide survey to determine the need for school buildings. The report of this commission was issued in December, 1952.

Then, in order to provide the information concerning needed schoolhouse construction that might be required in making decisions that will have far reaching effects on the future of public education in Indiana, I initiated a study of school building needs. The intent of this study was to bring the Commission's report up to date. The study was made by Dr. Beeman Phillips, Director of our Division of Research, and the report, *The School Building Crisis in Indiana,* was published in December, 1954. Such facts as have been revealed by this and subsequent studies have enabled us to know what the needs of the next few years will be, and to make concerted effort to supply these needs.

For just a moment let us consider why there is a critical shortage of classrooms. Although a number of factors have combined to create this situation, the major factor is population growth.

One way of looking at the population growth is to examine the birth rate. It is significant, not only because it affects population growth but also because it affects future school enrollments. The number of births in Indiana in recent years has been nearly twice what it was in the depression years. For instance, in 1937 there were 56,000 live births in Indiana; in 1941 there were 66,000 births; and this number has increased steadily until in 1954 there were 109,008 babies born in our state.

The belief that this very large increase in the number of births will level off or even decline in the near future is not supported by the latest information available. On the contrary, data secured from the State Board of Health indicates that the number of births during this year so far will at least equal or even surpass previous figures. In fact, there is no sure way of accurately predicting whether there will be a leveling off or a decline in the number of births in Indiana in the near future.

This continued upward trend in Indiana births is significant because it means that building facilities must be provided for constantly increasing numbers of children. It also explains the present concern of the State Department of Public Instruction and of every school administrator in Indiana over available building facilities.

Since the birth rate ultimately determines the number of children in school, another way of looking at the school building problem is to examine enrollments in the public schools.

In the 10 school years from 1944-1945 to 1953-1954, inclusive, there was an increase of almost 150,000 pupils. In 1953-1954 there were 772,000 pupils in Indiana public schools, but from pre-enrollment figures it has been estimated that there will be 877,000 pupils in school in 1956-1957, and that by 1959-1960 the situation will be even worse, for there will be 995,000 pupils.

The number of school rooms needed for the six-year period from 1954-1955 to 1959-1960, inclusive, is estimated at 14,600 rooms.

You, in the field of audio-visual education, school administration, and school plant planning, who are all so vitally concerned with providing the best possible learning environment for Indiana's boys and girls, are vitally concerned with

the plans for those 14,600 rooms, for, as Winston Churchill is said to have advised the members of the House of Commons, "We shape our buildings and afterwards our buildings shape us." There are so many ways in which an educational program can be either helped or hindered by the buildings in which it is housed, and certainly the audio-visual educational program is no exception.

There is an old adage in navy circles which says that all activities of the Navy, even paper work in the office or weather watching in the center of a desert, have but one purpose—"to support the actions of the fleet." So it is with school buildings. They must be built and equipped for the purpose of facilitating an educational program, one phase of which is the audio-visual educational program.

Many people believe that audio-visual education is a new and effective way to teach. It is effective, but it is not new, for there are many evidences that even primitive man used pictures to instruct long before the advent of spoken or written language. During the long history of the development of educational methods, pictures have been an important way of presenting information, but the development of audio-visual education as a special field came with our ability to use recorded sound and with the enlargement of the part all kinds of visual materials play in modern teaching. Recorded sound and pictures that move opened a new vista for the classroom. Then World War II brought the necessity of training masses of men in a very short time, and audio-visual methods and materials were developed to accomplish this tremendous task. Perhaps this was responsible for the new interest that schools took in the program.

Even though schools were not the first to develop the use of audio-visual materials in their educational programs, they soon became enthusiastic over the potentialities of such media. Today we can not minimize the importance of good teaching. We must also agree that, as our teaching responsibilities increase, the amount of energy expended by our teachers must also be increased. The complexities of American life have added immeasurably to our duties, but we are the same human beings with the same length school days and more school responsibilities. We are living in a modern age, an age where mechanical developments have cut the working

hours of our fellow men. We of the teaching profession also need to be aided by tools and efficiency materials if we are to reach the new and extended goals our communities would have us reach with respect to their children.

Extravagant claims have been made by the Armed Services and by leading educators concerning the effectiveness of this new medium of instruction. Statistics have been compiled which indicate that even as much as a 50 per cent or more increase in the effectiveness of classroom learning can be made by the proper integration of audio-visual materials into the curriculum. It is not my place today either to substantiate or to deny these claims, but I do say that, even though these materials may not increase learning by 50 per cent, even though that increase may be as low as 10 per cent, it would still be worth-while! If by the use of these materials in a good classroom situation the boys and girls of Indiana schools can be taught 10 per cent more than they are being taught today, if the interest in learning can be increased by 10 per cent, they should certainly have full benefit of that increase. For there is little doubt that the proper use of sensory aids gives new life and meaning to the subject matter of instruction. Time is saved; pupil interest in all phases of the curriculum is heightened, and, most important of all, the retention span for the material thus presented is increased.

We still need the answers to many questions concerning the design of the classroom in which these materials will be used. We in Indiana need to know those answers, and we are looking to you and people like you to find those answers. Some of you have already been asked to help the State Department gather the specific data and recommendations that Indiana architects, school superintendents, and other interested persons can use in making classrooms and school buildings become better instruments for learning through the use of audio-visual methods. Many more of you will be asked for your help.

The boys and girls of Indiana are its priceless heritage. We look to you in this conference, and in similar conferences, to supply the answers—to give to us the information that will provide for them the classroom in which they can most effectively become adapted for the new world.

A SUCCESSFUL PLAN FOR THE ECONOMICAL AND EFFICIENT MAINTENANCE OF SHOOL BUILDINGS

Ronald Brown

A successful plan for the economical and efficient maintenance of school buildings is predicated first of all upon regular inspection of those buildings. When the buildings have been brought up to a minimum standard of safety and of effectiveness as a physical facility for educational work, economical and efficient maintenance depends upon detecting various maintenance problems in the incipient stage before they become serious and costly.

Boards of education have met this problem in a variety of ways, depending upon the size and structure of the school system and the personnel available to do the job effectively.

In the Cleveland Heights, Ohio, schools, where I have had experience, the best method for performing this regular inspection of the 17 buildings housing 11,000 school children was through lay committees who reported to the business manager. This lay committee was chaired by a member of the board and was composed of men in the community who were maintenance engineers of some of the larger industrial plants, building contractors, heating and ventilating contractors, and experts in various other fields of building construction and maintenance. The committee was divided into teams of two men each, and each team inspected one or more buildings, using a form that was especially prepared for their guidance.

In smaller systems, these inspections are made by the superintendent, by the business manager, by board members delegated to take responsibility for building maintenance, or by the custodian and/or principal of the school.

In larger centers the building and grounds department of the school system often has the personnel to permit these regular inspections without introducing lay committees or others.

In general, the inspection should be made twice a year—the spring inspection covering the entire building from roof to basement, inside and out; the fall inspection covering the

exterior of the building only, preparatory to the coming of winter.

Experience has indicated the importance of having all observations reduced to writing while the inspection is going on. These observations should then be submitted to the business manager or the person responsible for requisitioning work to be done.

In the system followed in Cleveland Heights and in many other systems that I have visited, this inspection report is posted to records, as illustrated in the slide that will be thrown on the screen.

This record is in the business manager's office and, once the report of inspections is posted to the record, the business manager obtains estimates of the cost of each item listed. There may be listed, in addition, other items submitted by the principal of the school or by the custodian of the school, and these will be added to the records, together with estimates of the cost of those items.

A meeting of the building and grounds committee is then held, and priority is determined with respect to the various items. The committee works against the amount budgeted by the board of education, though it does not feel bound by this amount. If it is felt that a larger amount should have been budgeted, the committee's report will so indicate and will tell why. When the items on the report are reviewed, it is possible to eliminate those which are of lesser importance than others so that the residual list represents the top priority items. The sum of these items is the amount to be budgeted for maintenance for the year. These priority items are then listed in order of priority to the limit of the budget. This insures that the most important work will be done within the budget.

It is extremely important in this connection that the board differentiate clearly between maintenance items and items of capital expenditure. Putting in new boilers, for instance, is a capital expenditure, not a maintenance item, and should be treated as such. Such expenditures should not come out of the maintenance budget. The same is true of new equipment, such as desks and other supplies.

Once the report has been accepted by the business manager and relayed to the superintendent, and through him to

the board, it is ready to be put into effect. It is the business manager's responsibility to put this plan into effect. He sets up controls, illustrated on the slides, which will tell exactly where the money is going and why it is going there. The advantages of this are patent. In the first place, the board is informed, and so is the superintendent. The business manager's records are simplified, and it is easy for him to assume accountability for the work done and the way in which it was done.

In the second place it builds good teacher-staff relationship and teacher-board relationship, because the teachers in the various schools can see at any time where the money is going and the relative importance of the uses to which the maintenance funds are being put. Instead of the work being done on a haphazard basis, with some teachers feeling that their school is neglected while others get the lion's share of the maintenance work, the tendency is for all to be satisfied, realizing that they are treated fairly and equally.

In the third instance, it builds sound community relations for the board, because the relation between the P.T.A. and the board is improved for the same reason that it is improved in connection with the teacher-board relationship described above.

There are four aspects of the interpretation of the building maintenance program which it might be well to discuss briefly:

1. The custodian of each school building should be considered an advisor with respect to that school building. He should accompany the inspection team when it makes the inspection. For that matter, the principal of the school should be invited to accompany the team. In some cases, the custodian will be the man who actually does the work on the building, but in other cases he can be important as a supervisor of the work being done. He should feel a proprietary interest in his own school, and the board should recognize this special quality of the custodian and give him a share in the responsibility for the proper maintenance of the building.

2. It is well for every school system to consider the case of the lay committee. In our community of Cleveland Heights, Ohio, we use a lay finance committee. I can give a number of examples of the value of such a committee, as well as of a

committee of buildings and grounds and committees having to do with various aspects of the curriculum and educational program. These committees are purely advisory, with no power at all. They report to the board, which invariably turns their reports over to the staff for study before it considers them at all. Some instances of the value of these committees would undoubtedly serve a good purpose.

3. A town meeting can be encouraged also. In Cleveland Heights we are using the town meeting held in junior high schools for entire areas served by that junior high school. These meetings are held for the purpose of discussing with citizens contemplated programs affecting taxes or affecting the schools in some other important way. It gives the people in the community a chance to express their opinion. We try to get those who represent varying points of view. It is the responsibility of the board to make its presentation as objective as possible and not to try to sell any one point of view. The board must be careful not to abrogate its own responsibilities to a group of this kind. It still must remain with the board to make the final decisions, and those decisions must be based upon the board's own best judgment. The board must not be unduly influenced by what people in the community with only a very limited knowledge think is the right thing to do.

4. The open board meeting is another important factor in getting ideas across to a community and carrying them along. In our school system it is common to have 100 to 150 or 200 people attend a school board meeting. About 100 is an average. A portion of the meeting is given over to comments from the audience, and at times when extremely controversial subjects are to be voted on by the board, people in the audience are given a chance to express their opinion after the motion is on the floor and before the vote is taken.

You may wonder what all this has to do with maintenance and operation of school plants. Our experience has been that good maintenance and operation of school plants will be achieved if various factors in the community cooperate and bring their best experience and knowledge to the school system. Why should not each citizen of the community do his small share toward making the schools safe, effective, educational institutions? There is no better place for good citizens

to practice democratic cooperation than in their local school systems. It can not be expected that a school system can employ the kind of staff that a large industry can to take care of building maintenance, nor can it always have people on its staff who are as thoroughly competent and well informed with respect to all types of building maintenance. In addition, it is not likely that a school can supervise the work going on to as great a degree as can a large industry supervise the work going on in its own plant. Therefore it is important to use lay people and trustworthy representatives of responsible companies in the building maintenance field. What I am suggesting is that school administrators attempt to make the operation of the school system more of a community endeavor, without in any way relinquishing their own responsibility. What is suggested here is the use of people in an advisory capacity to assist in doing a job well which is quite difficult for school people to do themselves. In addition, an attempt has been made in this paper to set up a very simple method to keep good, effective records of where your dollars are going when it comes to plant maintenance, to the end that your maintenance costs will be as low as possible and your maintenance work done as efficiently as possible.

I propose to pass out the forms used by Tremco that were shown in slides to those who wish them and will be very glad to answer any specific questions. (Samples of these follow.)

SETTING UP AN EFFECTIVE AND ECONOMICAL BUILDING MAINTENANCE PROGRAM

Until this program was instigated, many school systems have not known the exact condition of their buildings, and sometimes serious conditions have gone unnoticed. The following program not only provides a procedure for keeping tab on the condition of school buildings from top to bottom, inside and out, but it offers a system for organizing work to be done in order of its importance, budgeting the expense of taking care of buildings, and knowing at all times just what work has been done, what work is needed, how much has been spent, and how much remains in a budget for future maintenance work. The Tremco Organization is pleased to provide schools with this system, including the forms for operating

the program, on a complimentary basis. The Tremco Representative who serves you will be glad to help you get the program started. There is no obligation to the school system for any part of this service.

The Simple Basic Principle Behind This Program

This entire program is based on a principle that has proved itself in the maintenance of buildings for many years, namely, that *low maintenance costs result from regular inspection of every part of a building so that deterioration can be caught in the incipient stage.* Deterioration can be corrected at lower cost before it becomes serious. In order for this principle to work most satisfactorily, buildings that are already in a deteriorated state must first be brought up to a high standard of condition, and this program helps to bring about the restoration of deterioration that has already progressed. After that, this program proves its maximum economy and effectiveness.

The entire program is operated in eight simple steps described on the following pages. Sample copies of the forms used are included.

When this program was presented to the Association of School Business Officials at Cleveland in the fall of 1953, such interest was shown in the program that more than 100 school systems requested additional details and the forms with which to proceed.

8 STEPS TO A SOUND SCHOOL MAINTENANCE PROGRAM

(For schools in cities of 25,000-125,000 population)

1. *Establish a lay committee to inspect school buildings.* Use experienced maintenance men from local industry and contractors in the community.
2. *Conduct regular semi-annual inspections* (about April and October). Furnish the committee with the following forms on which to record the findings of their inspections:

   Inspection Record—Roofs (Form A)
   Inspection Record—Exterior Walls (Form B)
   Inspection Record—Interior (Form C)

3. *Inspection records are posted to the control.*

   Use the following forms for the control:

   Maintenance Control—Roofs (Form D)
   Maintenance Control—Exterior (Form E)
   Maintenance Control—Interior (Form F)

   One of these forms, like the inspection records, is used for each school in the system.

   In consultation with committee members, business manager, chief engineer, observed conditions are reviewed, tentative recommendations drawn up, with a priority schedule of work recommended. Submit report to Board of Education for review, budget considerations, and authorization.

4. *Requisition work authorized to be done.* Outline exactly what is wanted.
   Use Requisition—Form G—for this purpose.

5. *The Maintenance Order.* Getting work done and recording cost.
   Use Maintenance Order—Form H—for this purpose.

6. *General Control for Individual School*—Form I. How much is spent on an individual school and for what?

7. *Master Control*—Form J. How much money is spent on each school in the entire system and for what?

8. *Budget Control*—Form K. Comparative record for all schools, showing amount budgeted, amount being spent, and amount remaining.

DETAILED EXPLANATION OF EACH STEP

STEP 1. *Establishing a Lay Committee for Building Inspections*

Where a school system does not have sufficient paid staff to conduct regular and thorough building inspections, it has been found effective to appoint a lay committee, consisting of men in the community familiar with maintenance of buildings in their daily occupations, such as men from the maintenance or engineering departments of local industries and contractors in the community.

Such men are usually glad to volunteer their services as good citizens of the community. However, the committee should be large enough so that excessive demands of time will not be made upon any one individual member of the committee.
Divide the committee into teams of two persons each, with each team assigned responsibility for inspection of one or two buildings.

The business manager and/or chief engineer should conduct the initial inspection with each team in order to pass along pointers concerning conditions to look for and points to be

recorded. The custodian of each building being inspected should accompany that tour.

STEP 2. *Conducting Regular Semi-Annual Inspections*

It is suggested that the inspection teams go over every building in the system twice a year. April and October are good months.

Each team is given a set of the Inspection Record Forms (A, B, and C) for each school, on which are listed typical conditions to look for, with space for noting observations.

The inspection trips are usually scheduled for late afternoon week-days, or Saturday morning or afternoon, in order not to interfere excessively with regular duties of committee members.

When the committee members have made their inspection trips and filled out their Inspection Records, the forms are turned over to the business manager.

Carry-over of committee membership from one six-months inspection to the next should be encouraged in order to gain benefit of accumulated experience and familiarity with specific buildings.

STEP 3. *Posting Inspection Records to Maintenance Controls. Meeting and Report*

The business manager posts the Inspection Records for each school to the Maintenance Controls for each school. (These are forms D, E, and F, and there is a control for Roofs, one for exterior walls, and one for interiors, corresponding to the subject coverage of the Inspection Records). One set of the Maintenance Control forms is put into operation for each school, after which that set serves as a permanent record, to be added to following subsequent inspections.

When the Control Records are completed for all schools, a meeting of business manager, chief engineer, and members of the lay committee who made the actual inspections is held to discuss their findings, to make recommendations of work to be done, and to decide on the priority of work recommended, based on the seriousness of particular conditions observed, knowledge of budget problems, etc.

The result of their deliberations is put into a written report and sent to the Board of Education for consideration. The business manager usually makes some estimate of approximate cost of work recommended, especially any work given a high priority, and these estimates should accompany the report.

The Board acts upon the report, deciding whether to authorize the work—and how much. Budget considerations are of course very important in determining how much of the recommended work can be done.

Once the Board has acted, the business manager knows exactly what work is authorized to be done within the budget to be allotted.

STEP 4. *Requisitioning Work to Be Done*

The Requisition—Form G—is used throughout the school system for requisitioning any type of building maintenance. It is placed in the hands of custodians, principals, engineering department, business manager, etc. No request for any type of building maintenance is honored unless it is submitted on this form.

With this requisition before him, the business manager can compare the requisition with the inspections that have been made and the work that is scheduled to determine whether the work has a priority, whether it is an authorized job, etc. Note that all requisitions have to be approved by two individuals, assuring that some thought be given to requests to determine whether they are reasonable and necessary.

STEP 5. *The Maintenance Order*

When the business manager decides to move ahead with any maintenance job, he issues a Maintenance Order—Form H—describing completely the work to be done, whether to be done with the staff's own men or by outside labor, etc. Provision has been made at the bottom of this form to indicate that the job has been entered on the proper Maintenance Control. All Maintenance Orders must be returned to the business manager when the jobs are completed. The back of the form should be filled out at the time an order is returned, showing actual cost of work done. This cost can be compared with the estimated cost, as well as with the cost of the job the previous time it was done, where jobs are of a repetitive nature. There is also a place for proper authority to indicate approval of the finished job.

STEP 6. *General Control for Each School Covering 10-Year Period*

For each school one General Control for Individual School—Form I—is kept, on which to record actual work done. This control is used for a ten-year period, during which it shows where the money is being spent at the individual school and how distributed over the ten-year period. It also enables a comparison to be made between schools of the system, in terms

of specific kinds of expenditures. Such comparison is made by comparing the General Controls of the schools concerned.

STEP 7. *Master Control for 5-Year Period*

The Master Control—Form J—is kept in the business manager's office. On this control are listed all of the schools in the system, the amount of money spent for each school for exterior, for interior, and for roofs, covering a five-year period. On this Master Control it is possible to watch the balance of expenditures among school buildings.

STEP 8. *Budget Control*

On the Budget Control—Form K—are listed all of the schools of the system, showing how much has been budgeted during any given period for each school, how the money is being spent, and how much remains to be spent.

Information for this record is obtained from records for individual schools and from the Master Control.

Advantages and Benefits of This Program

Where this program has been in operation, the following advantages have been reported:

1. It costs no more to maintain a program of this kind than it does many less effective programs.
2. The records are condensed, easier to get at, and much easier to use than a system where records are scattered in files and books.
3. It results in more efficient and effective maintenance of school buildings at lower cost.
4. It assures needed work being done when the maintenance needs are in the incipient stage. One of the most costly results of improper maintenance programs is that needed maintenance is neglected until it becomes very serious and more costly, whereas the same job could have been done several years earlier for negligible or at least much less cost.
5. The Board of Education is better informed with respect to its buildings. Likewise the business manager is better informed. The chief engineer is able to get work done in a more satisfactory manner and do an even better job for the school system. Custodians like the program because it gives them a record of the work done on their buildings, eliminates any feelings that a particular building has been neglected, and shows them comparative information regarding each of their buildings. It gives custodians additional incentive to cooperate by pointing out work needed and in helping to get it done effectively and economically.
6. Criticism from the citizenry is minimized.

INSPECTION RECORD—ROOFS FORM A

NAME OF BUILDING _____ DATE _____

ROOF OVER _____ MADE BY _____

(Name and/or Number of Room Covered)

DATE OF LAST PREVIOUS INSPECTION _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
COPINGS Are stones porus, cracked, spalled? Are joints cracked, porus, disintegrated? Is there a drip on underside of exterior projection? Is joint between coping and parapet tight?	
PARAPET No seal which is vapor barrier should be applied. All joints should be sealed tight and be mortar joints.	
FLASHINGS Joint between counter flashing and parapet shall be tight. Flashing shall extend up high enough behind counter flashing to protect against piling snow, etc. Flashings shall be tight.	

INSPECTION RECORD—ROOFS FORM A

NAME OF BUILDING _____ DATE _____

ROOF OVER _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
PROJECTIONS Where vents, skylights, chimneys, etc. project through roof deck, the flashings around them shall be tight.	
FLAGPOLES, SIGNS, FIRE ESCAPE ANCHORS, ETC. A collar-like flashing should be applied to insure water-tightness and allow for movement.	
SKYLIGHTS—MONITORS Flashing shall be tight. All glazing should be tight. All wood and metal protected. Plaster shall be waterproofed—no cracks, etc. Roof of such projections shall be tight.	
DRAINS Should be clean and tight. Screens in plain. Proper pitch provided.	

INSPECTION RECORD—ROOFS FORM A

NAME OF BUILDING _____ DATE _____

ROOF OVER _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
ROOF DECK The deck upon which the roof is laid shall be sound. Crumbly spalled concrete shall be filled and made level; with soggy insulation removed; rotted or warped wood roof sheathing replaced.	
ROOF MAT Shall be clean of debris, dirt accumulation and shall not be dry or powdery—no blisters—not loose from base—properly pitched to drains—observe fish mouths at lap; cracks, breaks, leaks, especially around flashings, drains, ridges, edges, at gravel stops, in valleys, etc.	

(Make Sketch of Roof and Mark Areas Requiring Attention)

INSPECTION RECORD—EXTERIOR WALLS FORM B

DATE_____

NAME OF BUILDING _____ MADE BY_____

DATE OF LAST PREVIOUS INSPECTION_____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
ABOVE GRADE *Projections*—Cornices, belt course, sills, etc. Masonry shall not be porus, cracked or spalled. Bed, face, top, end and soffit joints shall be tight and pointed with mastic.	
WINDOWS Shall be tightly caulked at head, joints and sills, all putty in windows shall be tight; all windows painted; all sash ventilators shall be draft-free. Steel lintels shall be free of rust and the opening above them shall be free to permit egress of moisture in the wall.	
WALLS All masonry shall be pointed (brick with mortar, stone with mastic); all loose, cracked or spalled areas made tight and safe. All stucco or concrete shall be made water-tight and safe. Joints between walls and sidewalks or driveways shall be tight.	

INSPECTION RECORD—EXTERIOR WALLS FORM B

NAME OF BUILDING _____ DATE _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
BELOW GRADE All walls shall be dry in all seasons.	
WALKS, DRIVEWAYS, STEPS, AREAWAYS, ETC. Shall be safe: where over basements, etc., should be watertight and safe; where adjoining building wall, should be pitched away from wall.	
PLAY AREAS AND EQUIPMENT, FENCES, ETC.	
LAWNS, SHRUBS, ETC.	

INSPECTION RECORD—INTERIOR FORM C

DATE _____

MADE BY _____

NAME OF BUILDING _____

ROOM, HALL, FLOOR, ETC. _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
LIGHTING Take light meter reading in 3 different locations—should be 35-50 footcandles. Kind; quality; dirty fixtures, etc.	
CONDITION OF PLASTER	
CONDITION OF ACOUSTICAL TREATMENT, IF ANY	
PAINTING—(Indicate Colors) Walls—(dado if any) Ceilings Trim Windows	
CHALKBOARD—(Color and Condition)	
FLOORS—(Light or Dark; Condition)	

INSPECTION RECORD—INTERIOR FORM C

NAME OF BUILDING _____ DATE _____

ROOM, HALL, FLOOR, ETC. _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
DRINKING FOUNTAINS, SINKS, BASINS, ETC.	
DESKS, TABLES, COUNTERS, ETC. Light or Dark; color; condition	
DOORS AND DOOR CLOSURES	
STAIRS—If any Railings Treads Landings	
BULLETIN BOARDS Color; condition	
HEATING	
VENTILATING	

INSPECTION RECORD—INTERIOR FORM C

NAME OF BUILDING _____ DATE_____

ROOM, HALL, FLOOR, ETC. _____

WHAT TO LOOK FOR	WHAT WAS FOUND AND WHERE
CLOAKROOMS	
CUPBOARDS, ETC.	
IN TOILETS Basins Urinals Bowls Sanitation Safety (cracked or broken glass or tile)	
AUDITORIUMS AND GYMS Stage floor Stage or gym equipment Curtains and tracks Ropes, scenery, hangings, etc. (safety) Lighting and electrical equipment	
BOILER ROOM Except for walls, ceilings, floors and painting of equipment, it will be the responsibility of the chief engineer to submit a detailed mechanical report on each school.	

MAINTENANCE CONTROL—ROOFS

FORM D

SCHOOL _____ ROOF OVER _____

Insp. Date	Inspection Indicates	Year Sched.	Est. Cost	Order No.	Date Done	Actual Cost	Code									
							Cop-ing	Para-pet	Flash-ing	Vents	Sky-lights	Valleys	Drains	Point-ing	Base & Mat	Misc.

MAINTENANCE CONTROL—EXTERIOR

FORM E

SCHOOL _____ ROOM NO. OR NAME _____

Insp. Date	Inspection Indicates	Year Sched.	Est. Cost	Order No.	Date Done	Actual Cost	Code						
							Paint-ing	Water-Prfg.	Point-ing	Land-scape	Walks	Play Areas	Misc.

MAINTENANCE CONTROL—INTERIOR FORM F

SCHOOL _____ ROOM, FLOOR, ETC. _____

Insp. Date	Inspection Indicates	Year Sched.	Est. Cost	Order No.	Date Done	Actual Cost	Code							
							Plaster	Painting	Cleaning	Floors	Equipment	Lighting	Heating	Misc.

REQUISITION FORM G

NO._____

SCHOOL_____ DATE_____

QUANTITY	DESCRIPTION

WORK

DESCRIPTION

APPROVED:

NAME	TITLE	DATE
NAME	TITLE	DATE

REQUISITIONED BY:

_____

COST

MATERIALS USED

Quantity	Description (Give Brand Name and Company from Whom Purchased)	Order No.	Check if from Stock	Cost

LABOR EMPLOYED

Hours	Name of Employee	Rate	Total

Total Cost _____

Estimated Cost of This Job $_____

Total Cost Last Time Job Was Done $_____ Date_____

Date Started_____ Date Finished_____

Finished Job Approved by_____ _____

Custodian Foreman

GENERAL CONTROL FOR INDIVIDUAL SCHOOL FORM I

SCHOOL _____

	19__	19__	19__	19__	19__	19__	19__	19__	19__	19__	19__
Roofing											
Pointing & Waterproofing											
Exterior Painting											
Interior Painting											
Equipment											
Floors											
Exterior Walks & Grounds											
Play Areas											
Cleaning Costs											
Eng. Equipment, Boilers, etc.											
Lighting											
Miscellaneous											

MASTER CONTROL

FORM J

School	19__			19__			19__			19__			19__		
	Ext.	Int.	Roofs	Ext.	Int.	Roofs	Ext.	Int.	Roofs	Ext.	Int.	Roofs	Ext.	Int.	Roofs

BUDGET CONTROL

FORM K

DATE _____

Insp. Date	School	Budgeted for 3 Year Period	Amount Spent Up to Start of Current Year	To Be Spent in Current Year	Estimated Balance at End of Current Year	Actual Balance at End of Current Year

REHABILITATION OF SCHOOL BUILDINGSS FOR AUDIO-VISUAL USE

E. Eugene Higgins

The senses of vision and hearing have always been the more important ones for education, but through the years we have come to depend more and more on the printed word or picture for communication of experiences. In 1951 Dr. Harmon estimated that at least 80 per cent of a child's time in school was devoted to tasks involving close visually-centered activities. Our Navy is reported to have estimated that we have learned 75 per cent of what we know through the sense of sight, 13 per cent through the sense of sound or hearing, six per cent through the sense of touch, and the remainder through our other senses. On this basis, 12 per cent was left for the olfactory and gustatory senses, or the two in combination.

As our knowledge of the importance of vision to learning increased, it had marked influence on school design in daylighting, artificial illumination, the finish and reflectance of interiors, including furniture, and other elements of the environment. In view of the need for speed and ease in seeing, and with consideration for the unfavorable conditions presented by small tasks, we have directed our efforts for the improvement of visual conditions to illumination with proper control and desirable contrast. Of the four mutually interrelated and interdependent variables—time, size, brightness, and contrast—increased brightness has probably received the greatest attention.

Let us take a moment and review the development of classroom lighting. It was not until 1914 that evidence of scientific attention to the illumination of children's tasks appeared. That year the British Illuminating Engineering Society reported the finding of from one to eight footcandles on desks where reading was being done in schools. This resulted in several recommendations involving the physical environment, all aimed at increasing the task brightness. The following year Luckiesh criticized conditions observed in America and recommended 2½ footcandles on desk tops.

By 1920 Caldwell's *Good Lighting in Schools* reported on (1) recognition of increasing percentage of eye defects; (2) difficulty of visual tasks; (3) inadequacy of illumination in schools; and (4) generally poor practices in using eyes, as contributing to increasing defects, with poor light as one of the factors. So through the years window areas have been increased and redesigned to improve daylighting, and developments in artificial illumination have progressed from the 1 2/5 lumens per watt of Edison's first incandescent lamp of 1879 to today's 65 lumens per watt for some of the fluorescent lamps. On the basis of studies by the Illuminating Engineering Society, the American Institute of Architects, the American Standards Association, and others, by 1948 the current *American Standard Practice for Schoolroom Lighting* was adopted, calling for 30 footcandles of maintained illumination at the desk tops for regular classroom work and specifying limits of brightness ratios between the visually centered task and its surround.

Some progress in increasing learning by improving conditions of seeing was reported in 1936 by Allphin, who reported 28 per cent improvement in reading for well-lighted groups. Two years later the extensive research of the Texas Inter-Professional Commission on Child Development was begun under the direction of Harmon. Intensive study of the effect of classroom environment began in 1942, and examination showed an incidence of 53.3 per cent of visual difficulties. Improvement in seeing conditions in an experimental school, including daylighting, reduced these difficulties by 65 per cent over a period of only six months.

The significance attached to this somewhat chronological presentation is that within a period of three or four decades we have recognized certain environmental problems involving the growth, development, performance, and well-being of children in school, essentially problems related to visually centered tasks, and we have done very well in determining solutions and taking appropriate action both in the design of new facilities and in the renovation, rehabilitation, or alteration of old buildings.

Although the motion picture was invented in 1893, it was not until about 1915 that it began to come into use as a visual aid to teaching. Silent moving pictures were usually shown in

the school auditorium, with the 35 mm. film being manually cranked through the projector in a booth made almost unbearably hot by the heat from a carbon-arc lamphouse. While the carbon-arc lamp should be condemned for its discomforting heat, it must be given credit for its high lumen efficiency, as it presented little problem in darkening the auditorium sufficiently for satisfactory projection.

As moving pictures developed, cellulose acetate replaced nitrocellulose film for safety; feed sprockets became motor driven, replacing the tiring work and irregular speed of the hand crank; the filament incandescent lamp came into use, and application of mechanical ventilation to the lamphouse diminished heat for both projectionist and equipment; the 16 mm. film was developed; and two years later, in 1926, the latest major improvement came when movies acquired a "voice."

For education, probably the most significant development was the 16 mm. film in 1924, for this development increased the portability of the projector, permitting moving pictures to leave the auditorium and go directly to the principal area of instruction, the classroom, and thus increased its usefulness as a teaching aid. The high degree of success with audio-visual training films in the accelerated programs of World War II gave great impetus to the audio-visual movement at the close of the War. An Eastman Kodak official pointed out that the number of 16 mm. projectors in use in the United States multiplied 16 times between 1940 and 1954. Before the War there were 25,000 projectors; the figure had increased to 400,000 by January, 1954.

But as motion pictures went into the classroom, interrelated problems were created for at least four agencies: (1) the projector manufacturer, whose product was now expected to have a performance quality superior to that of the expensive equipment of the commercial movie theatre, since projection for mere entertaining was considered to be less exacting than that for educating; (2) the filament lamp manufacturer, whose product was expected to make a reasonable approach to the brightness efficiency of the carbon-arc lamp; (3) the screen manufacturer, whose product was expected to overcome much of the inefficiency of the lumens-at-screen brightness of the projector and the attendant problem of

stray light from daylighting; and (4) the school administrator who had to provide facilities for the use of the projection equipment, including means of controlling the daylight.

In looking in more detail at these problems, let us start with the problem of delivery of electrical energy to the machine. Many of the old buildings did not have convenience outlets in the classrooms. By replacing live-front distribution panelboards with compact circuit-breaker type of interiors, using the same enclosing cabinet with an extension if necessary, more circuits can be obtained than are needed for the lighting requirements only. The added circuits can be used for convenience outlets. The new thinner thermoplastic insulation has enabled us to increase not only the quantity but also the size of conductors in a given size of raceway. Existing conduit runs from panelboards to classrooms can carry the new circuits to the most accessible ceiling light outlets, with unobtrusive surface-mounted Wiremold being installed from these points down to the desired locations for the convenience outlets. If a local switch does not already exist for classroom lighting, it may be added similarly by using Wiremold for the switch legs. Wiremold can also be installed to provide a connection between the rear of the room and a speaker outlet in the front at a point near the top of the screen location, where a hook or shelf should be installed in a manner that "aims" the speaker and sound at the audience area, eliminating the bothersome and dirty cord across the floor. This, of course, is service to be provided by the school division responsible for housing.

If further re-wiring is required, such as new sub-feeders, between the main panel and the distribution panelboards due to the increased load of the convenience outlets and/or relighting which may be done at the same time or anticipated for the future, the thermoplastic insulation again enables us to re-use existing conduits. It will be found to be advantageous to have three-phase four-wire secondary distribution in re-wiring if it does not already exist, since it affords a better opportunity to balance connected loads between phases. A further advantage accrues to the so-called wye connected secondary field, since the reduction factor to 80 per cent of maximum conductor capacity does not apply under certain encoun-

tered conditions. This affords maximum utilization of both old and new wiring.

Utility companies having well-regulated voltage normally supply single-phase service at either 115 or 120 volts, depending upon the method of transformer connection. Projection lamps are manufactured for standard voltages of 110, 115, or 120. Let us assume that the audio-visual supervisor "standardizes" on the 120-volt lamp. Its performance will be normal at its rated voltage—100 per cent of lumen output and 100 per cent of rated life—but when it is installed in a projector used in a building whose service is only 115 volts, while the life of the lamp goes up the performance in light producing lumens will be reduced 16 per cent for each five per cent of under-voltage. This is approximately the situation we would have. Since one of the factors of seeing is brightness, and brightness in projection is a matter of lumens-at-screen, with only 1½ to 2 per cent of the lamp lumens of a good projector in good condition passing through the optical system to reach the screen, we would certainly want to avoid a loss of 16 per cent of our light. Therefore, whether the building is old or new, it is important that projection lamps be purchased for the correct service. Care must be exercised in transferring projectors to other buildings, to see that the lamp is correct for the available voltages. It is the responsibility of the buildings administrator, in cooperation with the utility company, to maintain voltage not only in the school building but at the convenience outlet in accordance with the secondary service installed to avoid loss of projection efficiency due to under-voltage.

Most 16 mm. projectors will bear nameplate ratings of 10 amperes at 105 to 125 volts, and this can be misleading. One manufacturer points out that the motor operating the blower for the cooling system is equipped with a centrifugal governor, so that speed does not vary more than two per cent within this voltage range and hence does not materially affect operating conditions, which would include reduction in lamp life from inadequate cooling. While the projector *will operate* within the specified voltage range, the lamp *will* be affected by deviant voltage, as already mentioned.

The problem of electric supply does not end at the convenience outlet, however, since electricity of the required

characteristics must be maintained at the projector and not just at the outlet. Extension cords made up of the type of wire which the National Electric Code approves for use only with portable lamps, portable radios, portable clocks, and similar appliances which are subject to being moved frequently are sometimes found. The Code specifically disapproves them for use with portable projectors, and the conductors are not approved for any load exceeding five amperes. The average 16 mm. projector will load such a cord to 200 per cent of its capacity. Since the branch circuit to the convenience outlet is likely to be protected from overload by a 15- or 20-ampere fuse or circuit breaker, preferably the latter, the resistance of the conductors to the overload will cause them to heat, damage the rubber insulation, and present a definite fire hazard. I once had a floor in a classroom set afire under such circumstances. If the requirements of the National Electric Code are met, removing any problem of voltage drop, heating of the cord, and rapid depreciation, a cable such as type S or ST, with No. 14 wire, should be used where an additional length of extension cord is required between the convenience outlet and the projector. The extension cord is usually considered to be equipment provided by the audio-visual administrator, since it is unattached and portable.

To better understand other interrelated problems, let us consider a situation which is not too hypothetical. Suppose our projector is equipped with a 750-watt, 120-volt, 25-hour projection lamp. Such a lamp has a rating of 21,500 lumens. The spherical reflector of a good projector in good condition will redirect from 30 to 45 per cent of the light component reaching it toward the optical system. Due to the low efficiency of the total optical system of this same good projector in good condition, only 1½ to 2 per cent, or as little as 322 lumens, are delivered to the screen. Suppose the voltage at the lamp socket is 111 instead of the 120 for which the lamp was designed. This is a drop of nine volts, or 7½ per cent. As a result we have a 24 per cent reduction in the light output of the lamp, reducing our lumen output delivered to the screen to 245.

The projection lamp we are considering has a life rating of 25 hours. It will depreciate 15 per cent during its rated life, or at an average rate of 3 per cent for each five-hour

interval. This will reduce our lumens from 245 at start to 208 at 25 hours. It is important to remember that we have been considering a good projector in good mechanical condition. Depreciation and/or maintenance of the spherical reflector and optical system have not been taken into account, so that our situation at the point just reached is somewhat ideal. Certainly the reflector must be kept clean as well as the condensing and projection lenses. No figures are available on the per cent of efficiency loss from failure to keep them properly cleaned.

Continuing our examination of the hypothetical case, the recommended projection screen for classroom use is the 70-inch by 70-inch size. On the basis of data appearing in the Illuminating Engineering Society's *Lighting Handbook*, the Society of Motion Picture and Television Engineers recommends lumens-at-screen requirements for classroom projection using this size screen as follows: for 5 footlamberts for all parts of a matte screen, 218 lumens; for 20 footlamberts for all parts of a matte screen, 870 lumens; and for from 5 to 20 footlamberts for all parts of a beaded screen, 190 lumens. Data are not given for the new aluminized metallic surface without beads, which is reported to have proved superior for reflecting the widest range of colors that exist in the film itself.

Returning to our calculations on lumens-at-screen from the projector, we would probably want to use the beaded screen, since we have a maintained amount of 208 lumens up to time of lamp failure. The previously cited source points out that viewing positions for a beaded screen should be kept within 22 degrees of the projection axis, with seats no closer than 2½ times screen width and no farther back than six times screen width. If the observer is seated too close to the screen, nervous strain and physical fatigue result from imperfections in the projected image and excessive eye movement in trying to scan the entire screen area. It may be of interest to note that the front row in our case would be about 14½ feet from the screen.

Many of our old classrooms are about 23 feet wide by 28 or 30 feet long, with 12 foot ceilings, so, if our screen is placed on the front wall (it is more likely to be on a tripod which will necessitate placement nearly 2 feet from the wall), and

three feet are allowed for circulation at the rear and side walls, an area only 17 feet wide by 10½ or 12½ feet long will be left for projector, operator, and audience. At the minimum allowance of six square feet per pupil, we barely squeeze 30 pupils into the smaller size room. Of course, this is all predicated on movable seating; in a classroom having the screwed-down, fixed seats, it will be impossible to accommodate as many, because of the characteristics of the beaded screen and the distance from screen to front seats. Can this problem be satisfactorily answered by replacing the fixed seating with movable furniture? Perhaps so, if we neglect consideration of another aspect of the problem of vision as related to the projected picture.

Research has indicated that desirable seeing conditions exist when the brightness of the surround and the task are relatively uniform. Balanced brightness conditions help the accomplishment of the seeing process and are beneficial in aiding impaired vision, minimizing visual strain and fatigue, and providing happy and cheerful environment. For classrooms, the recommended limit of brightness ratio between the seeing task and its visually adjacent background is 3 to 1.

Our brightness in lumens-at-screen previously considered ranged from 245 down to 208, for an average of 226. So this should be three times brighter than the adjacent background surround, in this case the front wall including its chalkboard. We shall hope that this front wall has been painted in accordance with currently recommended good practice, so that its reflectance is around 65 per cent. The chalkboard, whether slate or the new yellow-green type, will not have the same reflectance as the wall. Therefore shades or draw curtains having about the same reflectance as the wall should be used to cover the chalkboard during projection.

The brightness of our front wall, then, should be about 75 lumens. Our problem is to establish this brightness without introducing non-projected light on the screen. One method is to illuminate the front wall with a "direct" system, so that only the reflected light to establish the desired screen-surround ratio reaches the audience and none reaches the screen directly. This will require .27 footcandles for the desired front wall illumination level to be provided by supplemental lighting.

It is suggested that our supplemental lighting be suspended from the screen support about midway of the room height, using two direct reflectors whose light distribution curves will require a spacing factor of one times the mounting height. When the luminaries are concealed behind the screen, the spacing factor becomes about 5 feet. Two 10-watt inside frosted lamps will meet the requirements for .27 footcandles at the plane of the front wall. This supplemental lighting would properly be considered audio-visual equipment, but the administrative officer responsible for the school plant would have to see that a convenience outlet was installed.

Getting back to our seating question, we have now had to bring our screen forward approximately six feet to establish an acceptable limit of brightness ratio with respect to the front wall. After the three-foot back aisle has been eliminated, our seating-projector-operator area will be reduced to 7½ feet long by 17 feet wide and 9½ feet long by 17 feet wide, respectively, for the 28-foot and 30-foot classrooms. If full flexibility of seating is possible, at the minimum of six square feet per pupil, we can seat only 21 or 27 pupils.

Here another interrelated consideration needs attention. We have been dealing with a 70-inch by 70-inch screen, with distances of 28 feet and 30 feet, respectively, from screen to rear wall without the supplemental front-wall lighting, and of 22 and 24 feet with the desirable controlled brightness. Allowing three feet for the projector, and using the normally supplied 2-inch projection lens, our pictures will be 56, 60, 43, and 47 inches wide for the respective conditions. It will be better to use the 1½-inch focal length lens for the balanced brightness situation, widening the projected images to 57 and 62 inches, respectively. In making such a change, we increase the brilliance of the picture slightly, which is desirable. The unalterable lengths of classrooms make it necessary to exercise care in the selection of audio-visual equipment, if maximum utilization of the preferred 70-inch screen is to be achieved.

This brings us to a consideration of control of daylight to reduce non-projected light on the screen to a level which will not interfere with projection. This is perhaps the most controversial of our considerations, because of failure to take

into consideration the numerous other factors which we have discussed here. There is some measure of agreement that 1/10 footcandle of over-all illumination is acceptable and will allow a degree of teacher observation of results during the activity. Obviously, such a level is woefully inadequate for satisfactory note-taking by pupils when we consider that the currently accepted practice is 30 footcandles at the desk top. It might suffice, however, for a "memory-jogger" entry to be expanded under more favorable conditions. Since the 1/10 footcandle is approximately five times the intensity of moonlight, it is believed that the reflected light from the screen and the supplementally lighted front wall may establish this level within close limits.

Thus the conditions we have developed lend themselves to night projection also, and enable us to black-out the fenestration for daylight projection without violation of the principles of good seeing conditions so far as the projected image is concerned. Since equipment required for the control of daylight is attached to the building, so that it is not readily portable, it becomes the responsibility of the buildings department to provide it. Ideally, the device would meet the requirements of daylight control for the predominating regular classroom activities as well as for those of darkening for projecting. The venetian blind has numerous advantages for both situations. Daylight can be controlled, including its redirection by reflection from the top of the slats if the teacher is alert to the variations in brightness outdoors. Baked enamel finishes are available within acceptable contrast ratios with the adjacent-to-window areas. In older buildings having no mechanical ventilation system, the blind does not render window ventilation completely ineffective. If the classroom does have mechanical ventilation, such as unit ventilators, having the blind recessed within the window opening would not interfere with the operation of the ventilators at all.

Mechanical maintenance for a blind assembled from good components is relatively little, since only the pull-up cords and ladder tapes are expended in time. We hear complaints about custodial maintenance for blinds, and we just let the old fabric shades get dirtier and dirtier and finally rot, and then we replace them without any cleaning. Custodial service employees who have high standards for their housekeeping

have found effective laundering methods. There is practically no fire hazard in a metal slat blind, but the last classroom fire I had occasion to investigate was spread over the window wall and finally to the floor by shades, one shade having been set afire by a pupil who had taken a "dare" from another. When a missile is tossed through a window pane, it frequently penetrates the shade also, unless the shade is made of lightweight duck, in which event it controls the daylight only by shutting it out, since it is not translucent. The blind can not suffer such damage.

For most effective use in darkening, particularly under conditions of extreme sunlight, some means must be provided for pressing the slats against each other while eliminating stray light around the ends of the slats. This can be accomplished, just as we have been doing with shades, by using a hinged vertical wing or flap. Commercially produced blinds having this light trap are available, and a demonstration model will probably be found in the exhibits. Other darkening devices used include woven, plastic, and plastic-coated Fiberglas drapes. These have been well received. They are usually hung from tracks mounted on the ceiling from 12 to 18 inches away from the window wall. They are darkening devices only, so that daylight control equipment is required in addition. Care should be exercised in the selection of drape materials, to avoid creating undesirable brightness contrasts when the drapes are open and the room is being used for its primary functions. The drapes also tend to obscure a part of the window area when open unless the tracks extend around the end walls, and then they may interfere with chalk or display boards. The drape must fit snugly to the ceiling and extend to from 12 to 18 inches from the floor. It can, therefore, interfere with the operation of a unit ventilator whose discharge grille would be behind the drape.

Due to the restriction of time, we have not touched upon many other audio-visual matters related to environment, such as acoustics, storage facilities, display boards, radio and television antenna installations, and listening booths. Little has been considered in connection with ventilation. Priority has instead been given to a brief review of the development of the daylighted classroom and its adaptation by darkening, specifically for 16 mm. projection, with a number of interde-

pendent and interrelated problems. As performance of the equipment has been traced from electrical energy through to the projected image, it is hoped that you will have been impressed with the fact that the solution to satisfactory projection lies in many relationships, each involved in the others. Many questions are suggested: Can a higher lumen output projection lamp be produced? Can a more efficient reflector and optical system be provided? Can a less directional screen suitable for use under conditions of higher over-all illumination be developed? Answers must come from the equipment manufacturers, and I am sure that American ingenuity will provide satisfactory ones.

BRINGING THE WORLD TO THE CLASSROOM

Spencer W. Myers

It we trace the course of human advancement, we find man's rate of progress has accelerated with each new means of communication. The beginnings of speech, the discovery of the art of writing, the invention of the printing press, the telephone, the telegraph, the motion picture, radio and television—each in turn has influenced man's mode of living. With each discovery of a new means of communication, this influence has increased a thousandfold. Consider, if you will, the progress from the middle of the fifteenth century, when movable type was discovered, to the dawn of the twentieth century. Compare this progress with that of the last 50 years, when the new mass media—motion picture, radio, and television—have made their tremendous impact. These media, together with modern transportation methods, have made all men neighbors.

This worldwide neighborhood, thrust upon us so rapidly, has created a tremendous need to increase the average citizen's understanding of the social, economic, and political problems of our own and other nations. It has made necessary a greater emphasis upon human relationship, and a vital need to bring the education of children and youth into focus with the world in which they must live and work. School people who fail to recognize these new responsibilities are retiring to the traditional ivory towers and limiting the chance for the survival of American democracy.

If, on the other hand, we make effective use of today's means of communication, we bring to the classroom a sense of participation in the events of our time. The immediacy and intimacy which these modern tools lend to the learning process give new dimensions to teaching. Such devices help teachers to make the events of yesterday a part of the reality of today and the promise of tomorrow. They can influence learning just as they have influenced living throughout our world today.

Let us consider this problem as it relates to the educational temper of our time.

What is the setting in which we face our tasks in education today and how will it alter in the next 10 or 20 years? There are at least four factors to consider: First, there is an unparalleled demand in this country for educational service at all levels—preschool, elementary, secondary, college, and adult. Second, education at all levels is of unprecedented importance, for it is basic to the security and growth of America. Third, this demand and this need come at a time when there is widespread misunderstanding of the nature, objectives, and requirements of educational service. Fourth, we face the new load in education with insufficient teachers, inadequate tools, and a very great lag between professional knowledge and professional practice.

The educational film is one of the few known possibilities to help significantly in meeting the new load. From experience of the last 20 or 30 years, we know of the efficacy of the film, of its part in the learning process. Research is needed for its further development; but on the basis of what we now know, the film appears to be indispensable in the tasks ahead.

Dr. David Henry reminded us that, if we are "to meet the staggering demands upon the schools of tomorrow which face a tremendous increase in pupils and a shortage of three or four hundred thousand teachers, the film must be used as a primary aid to conserve the teacher. At long last, we are beginning to do in teaching what was done some time ago in medicine, where the doctor's hands and arms have been extended by use of the worker in allied professions and in paramedical sciences. In occupational therapy, in optometry, in work with the handicapped, in a dozen other medical services, the doctor is now captain of a team, and his wisdom and knowledge have been extended through the arms and eyes of other people. So with nurses, we no longer ask the trained specialist to do tasks that an ordinary hospital orderly can do; we're asking her to supervise the team."

It is about time to take a good look at our classrooms—to discuss ways to relieve the teacher of the routine and the mechanical, and to conserve him or her for the main task in teaching the individual child. Much group instruction can be done effectively with a film, a tape recording, a radio or television program, leaving the teacher to do the "follow up" and the real teaching. We are not going to live up to our

responsibility as educators in today's world unless we take this approach.

These new media can help the teacher bring additional showmanship to the classroom. Educators often frown upon associating the word "showmanship" with teaching, but a good teacher is essentially a good showman. In these times when youngsters have television in the living room, radios in their bedrooms, a movie house around the corner, gunplay, adventure, and classics in wire racks at the drug store, a teacher has to be a pretty successful showman to compete with out-of-school interests.

The nature of the school scene is quite different from that of 50 years ago. Not only do all children have access to hours of excitement and vicarious adventure, but the schools are serving all the children of all the people—the brilliant, the dull, the interested, the apathetic, the problem child, the physically handicapped child. In the early part of the twentieth century, this was not so. Critics of the schools often forget that one of the big differences between the schools of their day and those of today lies in the fact that we are trying to make every child as socially and economically competent as possible. We have only begun to meet this problem. The newer communication techniques can be a big factor in helping teachers meet the varied needs of all of America's children.

Just as we recognize that differences in children affect the curriculum, so must we admit that changing world conditions increase curriculum responsibilities. The authors of the American Association of School Administrators' Thirty-second Yearbook, titled *Education for American Citizenship*, described the newest responsibility of education to be "education for citizenship in many communities—family, school, neighborhood, local, state, national, and lastly, world. . . . The greatest struggle of our age is found within this all-inclusive circle. The advances in science and technology have relentlessly destroyed the significance of the natural boundaries of rivers, mountains, and oceans which once separated peoples and isolated smaller communities."

Dr. Walter Wittich of the University of Wisconsin posed this question in the April issue of *Educational Screen*: "How can we best communicate ideas and understandings to youth preparing to live in this larger, more dangerous community?"

He answered the question in this way: "It is through the experiences communicated by audio-visual means that understandings about things too far away to be visited, too inaccessible to observe first-hand, too small, too slow, too large, too fast, to be seen first-hand, can be interestingly and meaningfully explained."

In Flint we are trying to develop effective use of the communications media. We have an audio-visual service and a board of education FM radio station which broadcasts some 20 hours of programs each week for classroom use. When television comes to Flint, we shall explore its possibilities in the educative process.

I should like to say here that it is particularly gratifying to find people heading two allied areas of work who are more interested in the end result of their services than in promotion of their own particular departments. John Ackerman, who heads our audio-visual center, and Ola Hiller and her radio staff work together harmoniously to provide the greatest possible service to Flint classrooms. They cooperate, too, in interpreting the school's program to the citizens of Flint. For instance, they have developed five public relations filmstrips:

These Our Children—a sound filmstrip which helped win more than 20 million dollars in a special 10-year five-mill Flint school tax levy in June, 1953.

Books Alone Are Not Enough—a report to the Flint community on the audio-visual department, in January, 1954.

Flint's Neighborhood Primary Units—an audio-visual presentation of a new type of primary school housing in Flint, made in October, 1954.

The Mott Foundation Story—a 26-minute presentation of the extensive services provided for the Flint community by the Mott Foundation in cooperation with the board of education, made in March, 1955.

We Learn to Read—an earlier sound-color-slide presentation of the method of teaching reading in Flint.

Perhaps the best way to show an audio-visual service which attempts to meet the need of bringing the world to the classroom is to use an audio-visual technique.

The film which I shall show now is one of this series of public relations presentations produced by the audio-visual

center and the radio department of the Flint public schools. It is called *Books Alone Are Not Enough.* The original production of this film was in the form of a sound filmstrip with the narrative put on a tape. This type of sound motion picture, called a Film-o-graph, is made by fading or dissolving from one still picture to the next. It was developed and is used extensively by the United States Navy. Its cost is low because lip synchronization is not required on the sound track. The film was planned as an in-service teacher training device and as a P.T.A. public relations program.

The inquiring parent role is played by Mrs. Stephen Roth, wife of the local circuit judge. She is a product of the Flint schools, has two children attending school, and is astonished and excited at the progress that has been made in modernizing teaching methods since she left school.

Mrs. Myrtle Curtis, in the teacher's role has taught many years in Flint and was president of the Classroom Teachers organization.

Miss Gladys Edgar, in the principal's and teacher's role, is capable, is respected by parents, and has had long experience in the principal's office.

The use of names of local people and local classrooms has proved to be an effective public relations device.

Sequences showing the use of students as operators are a teacher training device and also illustrate the student training value of the audio-visual program.

This film shows how we are using audio-visual aids to bring the world to the Flint classrooms. However, it does much more than this. It demonstrates the teaching value of the sound motion picture. How else could we show a parent's reaction to modern methods used in several different audio-visual lessons in classrooms in Flint schools and bring that reaction to audiences in our own and other communities?

By what other means could we give a group of in-service teachers ideas on the use of audio-visual materials and at the same time show them how these materials should be used? What other device would reveal to new teachers or P.T.A. audiences a bird's-eye view of the audio-visual department in 16 minutes? In what better way could we present the teacher's willingness to study new audio-visual methods? In what finer way could we show acceptance of a negro teacher than to pre-

sent her demonstrating the good audio-visual technique of preview, preparation, presentation, and follow-up, as Mrs. Rolland does? Where could we find a more graphic way to recognize the contributions of civic groups to the audo-visual department? In what better way can we show citizens that we welcome their participation in school activities?

Community cooperation was illustrated in several sequences of the film by Mrs. Hardy showing films to homebound children and at the TB hospital; by Lieutenant Wilburn Legree, of the city police department, using audio-visual materials for school safety assemblies; by the dedication of a community school with Mr. Potter, member of the board of education, at the mike; by Mr. Grant demonstrating audio-visual equipment in Pierce Community School auditorium for our school-community day; and by the recognition of the financial support of community groups, such as P.T.A., service clubs, and others.

The sound filmstrip entitled *Flint's Neighborhood Primary Units* has proved to be another audio-visual device whose pictures and continuity stimulate human thought. We feel that it is the best way to bring a new idea in housing for primary children to audiences far and wide at a very reasonable cost. It helped our own people to understand that these units were really fine school facilities—not the traditional temporary buildings so well known in other periods of high enrollment. It served, also, as a fine sight and sound demonstration of this type of housing at professional meetings such as this, and for review by boards of education in other parts of the nation.

Out of his experience, Mr. Ackerman feels that there are five factors involved in the operation of an effective audio-visual program:

First, the program should have a staff of teachers trained to make effective use of audio-visual materials. Two areas need attention here: indoctrination or refresher courses for new teachers and continuous in-service training of staff members through audio-visual workshops, extension courses, teaching demonstration institutes, and teachers' guides or handbooks.

Secondly, the audio-visual program should have an adequate supply of good audio-visual equipment which must be easily available and simple to operate.

In the third place, it should include an adequate supply of good audio-visual materials—films, filmstrips, and recordings. These, too, should be available for use with proper machines at the proper time and place for effective instruction.

Fourth, a good guide should be available to all staff members. This should include a catalog of materials available from the audio-visual office; a list of source material available from local groups, such as General Motors, Ford, Chrysler, the public utilities, the electronics industry, and the railroads; and a listing of audio-visual libraries in and near your own state. For instance, our Mr. Ackerman uses, among others, the University of Michigan, Michigan State University, Indiana University, Michigan Department of Health, and Michigan Department of Conservation.

The fifth essential in an effective audio-visual program is an over-all organization and direction of the entire program from a central office. Two functions are involved in this organization and direction. The first might be called planning functions, which integrate the selection of materials through departmental conferences and previews before purchase; provide approved rental lists of films; set up means of evaluation; and guide the activities of building coordinators in centralizing authority and materials, cataloging materials, providing efficient distribution, and training teachers and student operators. The second function of the administration of an audio-visual department relates to its service and operating activities—that is, providing a guide or catalog of all available materials; providing efficient city-wide distribution of materials; training staff members in proper utilization of materials and equipment; and furnishing inspection, repair, and maintenance service for materials and equipment.

In spite of close attention to these five factors, we still have audio-visual problems that have not yet been solved. In the new community schools with bi-lateral lighting, we have tested most of the new so-called daylight screens, translucent screens with rear projection, and hooded screens. We find that darkening shades are the only satisfactory solution for classroom projection at the present time.

It was interesting to read Williams S. Hockman's article in the May issue of *Educational Screen* in which he discussed the normal versus the abnormal classroom. He maintained that in the normal classroom, the one which is not darkened

for projection purposes, screens must compete with events and objects both in and outside the room. Attention is far from total. In the darkened classroom, the screen gets a chance to make a stronger, more lasting impression on the child because the child's reaction is much less inhibited.

Other problems in audio-visual education requiring additional work for their solution include:

1. An objective program for the evaluation of the effectiveness of the audio-visual program.
2. A list of guides to govern the acceptance of sponsored films in the public schools.
3. The development of audio-visual materials for teaching about our local municipal institutions—the police department, the fire department, the water department.
4. The acquisition of more materials for teaching about the history, operation, and resources of our own state.
5. The ever-present problem of getting the right materials to the teacher at the right time.

The importance of a good audio-visual program in upgrading teaching in our time makes it imperative for administrators to give attention to its potentialities and its problems. The best audio-visual expert in the world can go only so far in building his program and overcoming its problems. He must have not only the support but the understanding of the total administrative staff.

Because audio-visual materials have the advantage of being available at the specific time at which a teacher can use them best, and because they can be previewed by teachers for more effective utilization, these aids perhaps will always be in greatest demand as teaching tools. However, if we are serious about the need to bring the world to the classroom, educators today can not ignore the potentials of radio and television. These tools raise a whole set of additional problems which deserve the attention of school administrators. Today's educational objectives can not be met on the basis of yesterday's schools. We must use all of the modern media to make world problems, which have suddenly become neighborhood problems, a reality to the boys and girls who will save or lose freedom in their time.

PLANNING SCHOOL BUILDINGS FOR INSTRUCTIONAL MATERIALS

Paul W. Seagers

School administrators are interested in a balanced school program in which all parts mesh for smooth operation. This operation must provide a maximum in educational returns, with a minimum of lag, friction, and inefficiency. Protagonists for any special phase of the program must of necessity get this concept or fail to make their maximum contribution to the total program. This is especially true in the instructional materials fields.

The library at first was more or less a repository for books and scarce or valuable materials. The librarian kept these books and materials in good repair and according to a system through which they could be easily found. As the librarian became more professional she became better acquainted with the school needs and either selected or aided in the purchase of the books. Subsequently, the good librarians made themselves invaluable by consulting with and giving guidance to both teachers and pupils. The advent and more popular use of microfilm has thrust a new medium at the librarian, of which the mechanics of storing, repairing, and using can be very perplexing. In this great age of science and mechanization it is conceivable that even more and greatly varying media will be thrown at the librarian or other specialists in the school.

This calls attention to the rapidly growing number of audio-visual education specialists, a specialty which resulted primarily from the development of 16 mm. sound pictures. It is true that there were audio-visual education courses, like the one I took in the mid-twenties, in some of our colleges. They were geared, however, to the classroom teacher and included the making of slides, the use of 16 mm. silent pictures, and the use of 35 mm. sound pictures in an auditorium type atmosphere. Audio-visual education received its real impetus during the war effort. Since that time the rapid improvement in equipment and the resulting need for more mechanical knowledge for servicing, and sometimes for operating the equip-

ment, have in many instances focused the specialist's attention too much upon the mechanics of audio-visual education and too little upon the philosophy and upon honest guidance to the ultimate consumer. Some universities, like Indiana, have recognized that danger and have taken steps to professionalize audio-visual education.

With expanding needs for instructional materials in days of limited budgets, it is easily seen how competition for the budget dollar can cause small cracks if not breaks between competing groups. The desire to justify and perpetuate our position is paramount in the minds of all of us. Unfortunately, these cracks have occurred to some degree at the national and state levels as well as at the local level. Before greater breaks can occur and before more school buildings are constructed, it is necessary for school administrators, librarians, and audio-visual specialists to get together and think through their philosophy and to cooperate in setting up a workable program. School buildings can not be planned wisely without this total cooperation.

If there is any justification for the existence of the library and the audio-visual facilities and services, it is to furnish educational materials to the user when needed. This means that these materials must be available to the teacher in the classroom for use during class time, either on a group or an individual basis. They must be available to the teacher at other times, either for preview, review, research, background, or recreational purposes. They must be available to the pupils for supplementary, research, review, drill, and recreational purposes. Where these facilities serve the community, they must be available for self-improvement, research, and recreational purposes.

It appears, then, that so far as the classroom is concerned some materials will be seldom used, some will be periodically used, and some will be frequently used. Those which are seldom used should be catalogued and stored in a central warehouse, those which are periodically used should perhaps be put into an instructional materials center in the building, and those which are frequently used should be stored in the classroom. The latter two places should be adapted to the use of the materials as well as storage. The central warehouse would furnish facilities primarily for construction, repair, and stor-

age. The remainder of this discussion will be focused upon the needs of the instructional or educational materials center located in the school building.

This center should not be a glorified library nor an expanded audio-visual department, although it conceivably serves the purposes of each. It should be located in a section of the building easily accessible to all departments. Its functions should be as follows:

1. Storage of materials. The storage of books, magazines, papers, films, filmstrips, slides, records, tapes, and pictures in such a manner that they can easily be selected, reviewed, used, or borrowed.

2. Repair of materials. Repair of all materials mentioned above.

3. Storage and minor repairs of all equipment necessary for the proper use of the above-mentioned materials.

4. Use areas. The provision of use areas, for either individuals or small groups, for all specialized materials requiring light or sound conditioning.

5. Conference and discussion areas. Special areas for the work of small groups for conference and discussion.

6. Areas for the creation of materials. Special areas for the creation of easily prepared materials as well as for monitoring and recording selected materials from radio and television.

All of these areas and elements should be related and tied together harmoniously, so that one person can give general supervision and guidance. This person can occupy a modest desk rather than a large charging counter, located centrally and near a door. Nearby should be the supervision office, where discussions of a more intimate nature can take place and where the general work facilities are provided. Adjacent to this should be the workroom for library facilities; also nearby should be the workroom for audio-visual facilities. Adjacent to the workroom for audio-visual facilities should be a small group viewing room for previewing, postviewing, and selecting teaching materials requiring a high degree of light control. The general book stacks should be adjacent to the book use area and a charging desk. In small schools the general supervision desk serves both purposes, while in large schools there is need for both desks. The book use area should

consist of tables and chairs and a scattering of more comfortable lounge furniture. Of course an easily accessible reference area near the main entrance is a must.

There should be a display and browsing area which should set the atmosphere for the entire center. Near this should be the informal magazine and periodical center furnished with lounge-type and comfortable furniture and set aside from the other areas by means of low screens, planting boxes, displays, and other devices. Not far away should be the teachers' professional corner, with a conference room nearby. Close to the audio-visual workroom and viewing room should be spaces provided with listening tables and viewing tables, and of course adjacent to this should be stacks for records, tapes, slides, and filmstrips. In large schools a supervisor's desk will be needed in a strategic position to supervise the use of these materials. The storage of film can be made in the audio-visual workroom or in a special room nearby.

Listening booths in this general area are a must. In these booths music can be played, speech can be recorded and played back, and the speaking of a foreign language can be practiced and compared with recorded examples. It would be highly desirable to have a room for the production of materials; however, much of this production could take place in the workrooms.

One thing we must prepare for is better use of the many fine things which come over the radio and television waves. The monitoring of these waves and the subsequent production of classroom materials from these sources requires a special room and facilities, preferably close to the general audio-visual areas. The legal and technical problems involved in this one phase need considerable study and research.

Put these all together and what do we have? An educational materials center! It can be used by teachers, pupils, and the public. It can serve teaching, supplementary study, research, and recreational purposes. It should be the nerve center of the school. Fantastic? Not in the least! These centers are now being designed for many high schools. The idea has been endorsed in books published by both the library and the audio-visual education associations. In spite of all of this we need more imagination on the part of architects and schoolmen in the planning of these centers. We need better

trained people for administering, operating, and using these centers. We need better leadership on the part of administrators in thinking through the total program and coordinating the work of the librarian and the audio-visual education people. We need more meetings like this, where architects, administrators, librarians, and audio-visual people can talk over their mutual problems.

PLANNING THE INSTRUCTIONAL MATERIALS CENTER

Margaret I. Rufsvold

In planning school buildings for the use of instructional materials, the librarian, like all other teachers, is concerned with every aspect of the school program—the objective, the teaching methods, the curriculum, the administration and staff, the boys and girls as individuals and as groups, the community in which the children live, and the resources that are available within the community. This is true because instructional materials are used throughout the school and are necessary components of the instructional process. Specifically, the librarian is concerned with the planning of the center where all of these materials are made available and from which they are circulated to all parts of the school or school system. The functions and purposes of this center must be clearly stated and completely understood by everyone concerned, particularly the architect. This is not a simple matter in any language, especially that of the educational expert. And so, before attempting to state the functions, purposes, and principles, we need first to define what we mean by such terms as audio-visual aids, materials center, and school libraries.

For our first definition we are indebted to an anonymous author writing in a recent issue of *School Executive* magazine:[1]

> Our attention has been drawn to a remarkable device which has been developed as a visual aid to education. This device teaches entirely through the eyes of the students. It can present with equal ease information of current importance, historical events, or imaginative flights into the future. It can offer instruction in the arts, the humanities, the sciences. With no moving parts to get out of order, it requires no special instructions for operation. It does not require a darkened room and it can be used equally well by artificial or by natural light. It is so cheap that

[1] *School Executive* 71:11, February, 1952.

the individual student may own one. There is practically no expense for repairs or operation; replacements are easily obtainable. It is light; it occupies little space; and it may be used in classroom, study hall, library or even in the student's own home.

This wonderful visual aid to learning is not new, however; it is called—a book.

When invented, in the fifteenth century, printing added a new dimension to enlightenment and education, and it has held its place of pre-eminence in the field of communications ever since. But the film and television have brought us another dimension, and that is motion. As Lancelot Hogben has so forcibly pointed out to us in his book entitled *From Cave Painting to Comic Strip:*

> Five centuries after Gutenburg the printed page can only suggest motion, even with the aid of stroboscopic photography. What is most novel about the film and about television as instruments of enlightenment is that they bring within the range of direct perception the whole gamut of scientific concepts which invoke the recognition of *time*—the mechanism of the clock, the motion of the celestial bodies, the vagaries of the gyrostatic compass, the development of the embryo. The static medium of the illustrated textbook can represent change and motion only by resources to elaborate circumlocution and abstractions which lie beyond the reach of any but the few with a trained and facile imagination . . . the animated picture can now make the *dynamical content of modern science* a commonplace of the daily experience of all of us.[2]

And so, in fewer than five decades we have developed motion pictures and television which perform a communication service not attainable through five centuries of print. The term "visual aid" came into use shortly after the first educational motion pictures made their appearance. In the

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[2] Hogben, Lancelot, *From Cave Painting to Comic Strip*, Chanticleer Press, New York, 1949, p. 237.

early 1930's the term included museum specimens, and collections of dolls, flags, or models, in addition to the silent film. The term did not embrace illustrated books or maps, the most visual of all aids to education at that time (and still widely used)! Later when the sound track was added to motion pictures, the term became audio-visual aids. But this new term was also exclusive, and in some circles it omitted radio and even television. By some paradox, however, the field trip became an audio-visual aid.

When we come to the word "library" we are again confronted with a label which has had different meanings in different periods. Most people think of libraries as collections of books, and yet the first known library was a collection of clay tablets in Babylonia in the twenty-first century B.C. Later, scrolls of papyrus and parchment replaced the tablets; print was considered unworthy of the finest libraries in the fifteenth century, but gradually it won its place also. Today the word "library" is applied to almost anything one cares to collect, and we have such labels as a medical records library, a film library, a recordings library, and so on. The greatest library in this country, the Library of Congress, contains examples of practically all of the media of communication invented from the time of the cave man to the comic strip. The catalogers of this library, experts in accurate description, have provided some new terms which should end the confusion surrounding the old phonograph record and its successors. Phonorecord is the generic word denoting all types of recordings; the specific types are called phonoroll, phonodics, phonowire, and phonotape.

When we come to the term "school library" we again have various connotations, most of them restricted or outmoded. For this reason, and at considerable risk of further muddying the water, we have come to prefer the term "materials center." In today's schools a satisfactory materials center grows and develops in response to the needs of the school program—without fear of departing from outworn, traditional patterns. Not merely as a place, but as an area of the curriculum, the center is an instrument of informative education, in fact, a method of education.

The Materials Center[3]

Teachers and pupils make a subject approach to materials which they need. How can the background information about life in Mexico in the sixteenth century be given to a ninth-grade class? What materials will help a fourth-grade class prepare to attend a symphony concert later in the year? How can a group of adolescents be given more security in their relationships with families? What are the differences in the views of current political aspirants? What materials would help with such requests?

For each of these, or for any other inquiries for materials, it is important that the teacher or pupil be able to discover readily what materials are available, whether books, films, or phonorecords, and to examine and select those which will best serve the needs of a specific group or individual at a specific time. For one purpose, a single book may be all that is necessary. For another, a film to be used as the basis for a discussion will be the beginning of an answer. In another instance, phonotapes, radio programs, books, and charts may be used, while in a question of present political views, magazines and recordings of current radio speeches may prove more useful. Whatever the answer, the teacher or pupil should have facilities in his school which make it possible for him to locate by subject, to examine, and to obtain easily any material available in that school system. Ideally, he should be able to learn of the existence of the material he needs and to get the material itself without having to explore several different school centers or to order materials months in advance from distant centers.

Experience and logic point to the need for providing a communication materials center within a given city or rural area which would serve all schools at both elementary and secondary levels and would provide all types of materials. The administrative patterns for providing this completely integrated service will vary. Some school systems will establish, directly under the Board of Education, one agency whose

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[3] Material in this section has been adopted from Audio-Visual School Library Service, by Margaret I. Rufsvold, American Library Association, Chicago, 1949, pp. 5-8.

function is to provide printed materials, films, radio, and television. This center operates through branches or centralized libraries in each school. Newark, New Jersey, is an outstanding example of a community where this plan has been operating successfully for several years. The program of such an instructional materials center consists of three major functions: (1) selection and use of materials; (2) production of materials; and (3) distribution of materials and administration of the program. We shall describe these functions in some detail, so that the architect can provide truly functional quarters for the center.

Selection and utilization of materials: services to teachers. The center keeps in close touch with classroom activities. When teachers are planning units of work, the librarian assists by providing catalogs, sources, and finding lists, and by informing teachers of evaluations made of these materials by the Educational Film Library Association and the reviews appearing in the *Saturday Review, Educational Screen,* and *Library Journal.* In addition, the center maintains a file of teacher and pupil evaluations of films used previously in the school. Up-to-date information on sources of films, slides, educational recordings, radio programs, and transcriptions is made available to teachers. New materials are obtained for preview. Teachers are assisted in the selection of related materials contained in the collection, e.g., books suitable for students of different reading abilities, maps, magazine articles, flat pictures, transcriptions. Community resources are suggested to the teacher through the evaluation file of school journeys, through the publications of the Chamber of Commerce, and through other sources arranged under proper subjects in the information file. Teachers are informed of educational broadcasts, of broadcasts of commercial radio networks suitable for particular grades and subjects, and of the availability of transcribed programs in the event that live broadcasts can not be received during scheduled hours. A teachers' guide or manual is furnished, together with related materials necessary to prebroadcast and follow-up study. Since flat pictures, illustrations in books, stereographs, maps, globes, and charts are essential accompaniments to teaching with radio and recordings, the center provides these at the proper time.

Finally, but perhaps most important, the center aids teachers in keeping abreast of new developments, research, and techniques in their special fields by providing and suggesting the use of current professional periodicals, books, and pamphlets along with such tools as the *Education Index*. Thus the center is indispensable to the in-service training program.

Librarians promote the effective use of all types of materials through individual conferences, group conferences such as departmental or faculty meetings, the compilation of typed or printed lists, and the arrangement of bulletin board exhibits and displays.

Selection and utilization of materials: services to pupils. The center serves pupils as individuals or as members of class groups. In the latter case it reaches the pupils primarily through its service to teachers and to their classes which come to the center to select, preview, and use materials. As individuals, pupils have access to all types of information and materials, both for reference and for recreational use. The staff helps teach pupils how to select and use varied types of resources, how to listen to recordings or broadcasts, how to view and understand films, how to improve reading ability, and how to develop appreciation and discrimination in reading. In the center and through its materials pupils are assisted in the pursuit of extracurricular activities; in planning assembly programs, dramatic productions, and club activities; and in the exploration of crafts, the fine arts, and hobbies. The center provides turntables and earphones for individual listening to music or dramatized programs. Listening booths are available for language study or speech correction via recordings; magnetic tape recorders are used by pupils for critical analysis of reading and speech disabilities. Educational broadcasts are received through earphones attached to library tables and controlled at the charging desk. Print and other graphic materials are provided to pupils concurrently with projected or broadcasted materials, thus making the latter more meaningful. For persons with defective vision there are books with large type, sight-saving books, and projected books. Pupils use the center's community resources file in planning individual or group study trips. They receive guidance in proper methods of reading maps, atlases, globes,

and charts. Through its exhibits, displays, posters, and bulletin boards, the center teaches informally. Because the library is available to pupils throughout the school day, before school and after school, pupils have free access to its materials and professional guidance in their use whenever a need arises.

Production of materials. The center plays an important role in the production of materials, both directly and indirectly. Objects, charts, posters, displays, mounted pictures, maps, and diagrams—all are produced in the workroom by pupils, teachers, and the center's staff members. Extending their services to provide newer media, the staff may record live broadcasts, important convocation speeches and assembly programs, school orchestra and band concerts, and dramatic productions. Thus the collection is enriched, and valuable materials are preserved for use at hours which fit into the class or school schedule. Such recording also provides an additional means of preserving school and local history.

Lantern slides and the newer miniature slides are instructional tools which are both inexpensive and easy to produce. Pupils can learn to make lantern slides in the elementary grades and to assist in producing materials which are useful in many subjects. The center, with veritable mines of information in its books, can present much valuable content simultaneously to an entire class of students when the materials have been transferred to slides.

In the production of films, filmstrips, and radio and television broadcasts more talent, experience, and equipment are required, but, given a reasonable amount of these three, members of the center's staff can become experts.

An important factor in producing any educational tool is the preliminary research and reference work required. Especially trained in this phase of the production job, school librarians contribute valuable assistance to all persons, both amateur and professional, who are engaged in production. Librarians, like other teachers, influence commercial production of audio-visual materials in much the same manner as they influence book publishing, i.e., by pointing out the weaknesses and strong features of existing materials and by suggesting subjects which need to be presented in films, slides, or broadcasts.

Administration and distribution of materials. Administering and distributing materials used in the audio-visual program is not a new phase in the school library for, like the above-mentioned phases, it comprises functions and services already provided for books and graphic materials. Thus, when the individual school library becomes the school's materials center, embracing all media of communication, it is merely extending its existing library program.

The librarian or director who administers the over-all program in a system involving several schools is responsible directly to the superintendent of schools and the school board. The director secures the necessary budget, selects and supervises the personnel of the department, and carries out administratively approved plans and policies which have been recommended by an advisory committee of principals, librarians, and teaching personnel. The function of the centralized department is to provide for the in-service training of teachers and librarians in the use of varied materials; to purchase and service instructional materials, projectors, and other equipment; to train projectionists; to catalog and process all materials so that teachers and pupils know what resources are available in each field; to record and evaluate the use which is made of the materials and services of the department; and to interpret its work to the board of education and to the community.

Quarters and Equipment for the Materials Center

We have certain basic standards to guide us in planning the physical quarters and equipment necessary for library materials centers. These are stated in terms of individual schools, with the assumption that a center serving a total school system would consist of somewhat the same components, increased in size in proportion to the number of schools and teachers to be served.

The preferred location of the center in the individual school is one easily accessible to classrooms and study areas, as far as possible from the gymnasium and band room, and on the first floor, especially if service is extended to adults in the community or if the school serves grades 1 through 12.

The reading rooms. In general, schools with an enrollment up to 500 will need to seat approximately 15 to 20 per cent of the students in the main reading room. In schools of 1,000 or more it will be difficult to maintain this proportion, but the proportion should never fall below 10 per cent of the enrollment. It is better to allow 30 square feet per reader than the old standard of 25 square feet per reader, in order to accommodate newer types of equipment without crowding the room. A reading room should never seat more than the number of persons who can be adequately supervised by the librarian or library staff, usually not more than 75 persons. Therefore, large schools will need to plan for two or more reading rooms.

If it is to meet the needs of the curriculum, the center will provide a minimum collection of 3,000 books in small schools and up to 10 books per pupil in larger schools. One running foot of shelving should be allowed for approximately eight average-sized books. If shelving is to be included in the architect's plans, then correct dimensions must be carried out. Dimensions for shelving have been included in almost every article on library planning, so there is no need to repeat them here. It should be emphasized that no shelf should be longer than three feet or it will sag, and no wall space should be left without shelving or cabinets, even under the windows and in conference rooms and work rooms.

Because of the trend toward large window areas, most schools will not provide the wall space to accommodate the total number of books and other materials required for good service, and therefore will need to use some free-standing open stacks, preferably integrated with the reading room. It goes without saying that all shelving should be adjustable and untrimmed. The wall shelving should include at least one unit equipped for displaying current magazines and one unit for newspapers. In addition to the shelving for books and periodicals, there should be at least one case for maps, charts, posters, and large pictures; cabinets with closed and sliding doors and adjustable shelves to accommodate phonorecords of various sizes; legal-sized vertical files for mounted and unmounted pictures, pamphlets, and clippings; and cabinets of proper size for storing slides, stereographs, and filmstrips.

Equipment for these materials should be placed adjacent to the areas where the materials will be used.

The card catalog will index all materials in the center and should be located near the charging desk. Unabridged dictionaries and atlases are most conveniently used when placed on special stands, never facing the windows. A special table with a book railing should be provided to accommodate the *Readers' Guide* and other indexing tools. At least one book truck, two bulletin boards, and a glass-enclosed display area should be provided.

The reading room should have at least one table equipped with playback machines and earphones; slides and filmstrips may be viewed by individuals in the reading room at a table fitted with small projectors or viewers. In addition, there should be at least two small listening booths or conference rooms which are soundproof and separated from the reading room by glass partitions to allow for listening without earphones. Obviously, electrical outlets must be provided freely throughout all areas of the library.

Instructional materials are usually charged out or circulated from a library charging desk. This desk can serve as the booking and charging area for audio-visual materials as well as for books. The old-fashioned U-shaped charging desk prevalent in most public libraries is not a functional type of equipment for a school, and its cost is usually excessive. Small schools will prefer to use an office-sized desk fitted with special equipment for charging trays; and large schools will prefer a sleek counter, again fitted with special equipment. The charging desk or counter will be located so that it faces the main entrance, not the windows, and should be as close as possible to the workroom and the card catalog. It is always well to provide shelving on the wall behind the charging desk.

Because the materials center encourages reading, viewing, and listening for recreation and for pleasure, it should provide one area with informal, lounge-type furniture, with attractive, well-selected materials close at hand.

Most reading rooms are rectangular in size, being the same width as the classrooms and the length of two classrooms. However, a wider reading room is more desirable if it can be constructed without pillars.

Preview and demonstration room. The preview and demonstration room should seat about 15 to 20 persons, and in new buildings it will have no windows. It will be artificially air-conditioned or ventilated. This room should have double universal service outlets at the rear and front, placed in load-bearing walls. In addition to the screen and the projector, there should be a table or shelf at the front of the room to hold the loud speaker, the phonograph, or the radio. This table should be approximately 12 inches higher than the general height of the students when seated. The preview room should also contain a desk with a shaded lamp for lecturing or taking notes, a demonstration table, a chalkboard, and a bulletin board. Some storage space should be provided for that part of the equipment which is to be used only in this room. However, the audio-visual materials and pieces of equipment which will circulate for use elsewhere in the school should not be housed in the preview room.

Processing and storage area. In addition to a reading room, the conference rooms, and listening and previewing rooms, the center will need a work area for processing and preparing materials. In a small school the work area, the librarian's office, and the storage area may be combined. In all cases this room should have an exit to the corridor. The equipment should include shelves for books which are being processed, large storage cabinets for equipment and supplies, a sink with hot and cold running water, and a work type bench with an electrical outlet. There should also be a sturdy table for inspecting, rewinding, and mending films and for minor repair and production work. A typewriter, office desk, and office files, in addition to the catalog which holds the shelflist, are essentials for this room. In large schools it is desirable to have a separate storage area for housing projection equipment and films, and for the inspection and rewind table. This area should have access to the workroom on one side and the preview room on the other side. Also, in large schools a small area should be separated with a glass partition, to serve as the librarian's office.

In larger schools it will be convenient to have at least one classroom adjoining the center. This room will be used not only for instruction in the use of the center and its mate-

rials but also for classes in which it is necessary to use materials in a discussion situation without disturbing readers.

Lighting, color, floor covering, ventilation, and acoustical treatment for the center will be in harmony with those provided elsewhere in the school plant. Because they are discussed elsewhere on the program, our discussion omits this phase of the subject.

The Professional Staff

A final word should be added about qualifications of staff for the instructional materials center. A professionally educated librarian is, first of all, a teacher, and second, a curriculum and instructional materials specialist. School librarians who were educated before film, radio, and television courses were available to them have subsequently completed courses in audio-visual materials. Here at Indiana University the curriculum in the Division of Library Science includes the selection, evaluation, use, organization, and administration of all media of communication, printed and non-printed. In addition, the potential school librarian completes three or more of the audio-visual courses available in the School of Education.

We feel very strongly that the person best suited to serve in such a center is the one who is concerned first of all with the educational content and purpose of materials and who knows how to select the best that is available regardless of physical format. Many so-called audio-visual media are more closely related to books than they are to each other as audio-visual types. A phonodisc of Carl Sandburg reading his own poetry is more akin to the printed text than to a motion picture on the workings of the inner ear. When we consider those visual representations which are capable of being printed on paper, such as maps and illustrations, it is difficult to say whether these fit more comfortably with books or with slides and filmstrips. And it is foolish to argue such a point; for the librarian with a knowledge of both fields will recognize their potential values in both places and will make them available.

For in reality, as the librarian of Stanford University, Dr. Ray Swank, has said: "We give people not wax, not phonographs, but the spoken word—the poem, the story, the

drama told aloud. We give them not film, not projectors and beaded screens, but the vision of life recreated for their pleasure and understanding. These are the things that books are made of too, and therein lies real unity. When sight and sound are fully accepted in the world of books, when the unity of content is fully recognized, we will have better libraries, better readers, and better people."[4]

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[4] Swank, Raynard C., "Sight and Sound in the World of Books," *Educational Screen* 32; 446, December, 1953.

PLANNING SCHOOL BUILDINGS FOR INSTRUCTIONAL MATERIALS FROM THE VIEWPOINT OF THE AUDIO-VISUAL SUPERVISOR

L. C. Larson

The breadth and diversity of the objectives of a modern school require a broad and varied program of learning activities. Such a program requires that teachers and pupils have an opportunity to use a wide variety of instructional resources which have come to include motion pictures, radio, television, graphic materials, and realia of all kinds. A school building which has been carefully designed to provide for the full curricular integration of these materials and the activities associated with producing, using, and evaluating them is a *sine qua non* in the development of such a program.

Because of the complexity of the teaching-learning process and the integration of all types of instructional materials, a number of factors operate in determining the most efficient type of school buildings. These factors are certainly not easily isolable nor are they mutually exclusive. For the purpose of this discussion, it seems these factors can best be considered as those which relate to (1) the types and areas of use of audio-visual materials in the schools, and (2) the philosophy, training, and objectives of the persons supervising audio-visual programs.

The first section of this presentation, therefore, is concerned with the design of the classroom, the normal place for utilization of audio-visual materials. The second section is devoted to other use areas, including the auditorium, cafeteria, and gymnasium. In order to make audio-visual materials and equipment easily accessible to teachers, pupils, and community groups, each school building needs an audio-visual center. Because the location and design of the center will depend upon the qualifications and the nature of the duties of the person who will be responsible for the audio-visual program, the coordination of the audio-visual program, Indiana's certificate for audio-visual supervisors, State Board of Education standards for audio-visual education, and sources of audio-visual building coordinators will be considered sepa-

rately. The last section of this report is concerned with plans for the school's audio-visual center.

Planning for Class Use of Audio-Visual Materials[1]

In planning for the class use of audio-visual materials, the architect and the school administrator are confronted with the problem of whether to design all classrooms for the use of audio-visual materials or to provide separate audio-visual rooms. An important consideration in arriving at a decision is the number of projection rooms which will be needed to accommodate teachers who will like to use projected audio-visual materials at some time during the class period. In an increasing number of better schools, teachers in many areas are beginning to use a projected type of audio-visual material during at least one period each week in each class they teach. To provide for this quantity of use, a ratio of at least one projection room to five classrooms will be required. The cost of original construction and maintenance of such rooms would greatly exceed the cost of providing for the control of light, sound, and ventilation of all classrooms. Furthermore, audio-visual materials are more effective if used in the regular classroom environment. Consequently, every effort should be made to design all classrooms to permit the proper use of motion pictures, slides, opaque materials, filmstrips, recordings, radio, and display and exhibit materials.

Light control. One of the most important deterrents to the satisfactory classroom use of projected materials is the lack of devices for controlling the amount of daylight which reaches the screen. It is true that in many schools motion

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[1] The writer has relied heavily upon *Planning Schools for Use of Audio-Visual Materials: Number 1, Classrooms,* by the Department of Audio-Visual Instruction of the National Education Association. Inasmuch as the original paper was given as an address at the 1955 Indiana and Midwest School Building Planning Conference, references to and quotations from the publication are not footnoted.

The work of the Steering Committee for the Indiana State School Planning Conference for Audio-Visual Classrooms under the chairmanship of Mrs. Altha Sullivan, Director, Division of Audio-Visual Education, Indiana Department of Public Instruction, has also been of value to the writer, even though references to it are not specifically noted.

pictures, filmstrips, and other projected materials are used with various types of so-called "daylight" screens in normally lighted rooms; but teachers who use materials in such rooms with little or no dimming of light report a lessening in the quality of the picture and a serious reduction in the effectiveness of the audio-visual presentation.

The outdoor theater industry has learned from experience that people will spend neither time nor money to view motion pictures out-of-doors before the period of deep twilight. This is the level of darkness at which there is not sufficient light to read a newspaper. In Bloomington at this time of year the desired level of darkness is not reached until around 9:00. The showing of trailers of commercial advertising, color cartoons, and previews of coming attractions may begin around 8:45 or a few minutes earlier, but usually the feature does not begin until almost 9:00 p.m. daylight time. There are several thousand outdoor theaters in the country. If projectors and screens were available which would make it possible for these theaters to begin the showing of films an hour and a half earlier, or between 7:00 and 7:30 in Bloomington, they would be able to schedule each day an additional showing of the feature picture which would add millions of dollars each week to the total receipts. With this amount of money involved, it can be assumed that the industry will immediately take advantage of any improvements in efficiency of light sources, optical systems of projectors, or reflective characteristics of "daylight" screens, which would make it possible to begin the showing of films earlier in the evening.

The available evidence and experience to date lead to the conclusion that projectors and screens, which are now available or will probably become available at reasonable prices in the foreseeable future, will not permit the satisfactory use of the different types of projected audio-visual materials in the classroom without light control facilities. For the effective use of projected visuals, the classroom should be capable of being darkened quickly and with a minimum of difficulty. The light reaching the classroom should be controlled so that the illumination in the room, particularly on the surface of the screen, does not exceed one-tenth footcandle. This is a level of illumination under which it is difficult, but not impossible, to read standard newspaper type.

Because of the variation in the intensity of outdoor light, it is difficult to provide light control facilities which will admit just the proper amount of over-all illumination for the classroom during projection. Since it is preferred that classrooms not be in total darkness, arrangements should be made for low level dimming of the artificial lights in the room.

The various methods of light control include shades, drapes, full-closure venetian blinds, and adjustable louvres. The type of room darkening should be determined during the preliminary stages of planning or before the final drawings and specifications are completed in order that structural equipment which will facilitate the installation of room darkening equipment after completion of the building can be provided or roughed-in.

Ventilation. Classrooms should be so designed as to provide for heating, cooling, and ventilating the room without noise or draft under all conditions of use. It is desirable that fast mechanical ventilation be provided rather than that natural room ventilation be depended on. The system should provide for the independent control of the ventilation of each room and should be capable of delivering a minimum of 15 cubic feet of air per minute per pupil at any time.

Acoustics. The building should be planned acoustically to permit good hearing of both speech and recorded sound. This acoustical treatment should make group activities within classrooms less disturbing, control noise from outside the classroom, and prevent sound within the classroom from being objectionable to outside areas.

Electrical installations. At least one convenience outlet should be provided at the front and rear of the room. Electrical outlets should deliver 110-volt alternating current and be fused for no less than 20 amperes. Lines serving the outlets should be separated from lines serving overhead lights and so designed as to allow simultaneous use of equipment in a number of adjacent classrooms without overloading the circuits.

Most new schools install central sound facilities. A simplified console will be satisfactory in most cases. However, provisions should always be made for plugging in radio and tape or disc play-backs or recorders. It is recommended that central sound wiring be carried in one and one-half inch in-

side diameter conduits, since such a conduit will permit the later installation of a coaxial cable which will be required for developments in the television field.

Other general features. Teachers on both the elementary and secondary level desire a room design which will permit small group activities. Space should be provided at the side or rear of the classroom unit to permit small groups or individuals to use or prepare various types of audio-visual materials without distracting other work groups in the room. One of the activity areas should include a sink and both hot and cold water.

Classrooms should be provided with adequate tack board and chalk board space which can be easily interchanged by maintenance people to allow for maximum flexibility of room usage. Horizontal display areas are needed for the exhibit of objects, models, and exhibits.

Each teacher should have at least one four-drawer legal-size file cabinet, a chart cabinet for the flat storage of pictures, charts, and maps up to 36″ x 36″, and a closet with adjustable shelves to hold miscellaneous supplies and materials. Also, provision should be made for the storage of other audio-visual materials and equipment which are either temporarily or permanently assigned to the classroom.

Other Use Areas

The cafeteria, auditorium, and gymnasium serve as multi-purpose rooms and provide space for a variety of school and community activities. Audio-visual materials can be used to an advantage in many of these activities, such as convocations, extra-classroom projects, and meetings of the P.T.A. and other community groups. Consequently, these areas should meet the standards of light control, ventilation, and acoustics recommended for classrooms and should have sufficient facilities so that all types of audio-visual materials can be used with minimum effort and maximum effectiveness.

Other important areas of preparation and use as well as sources of leadership and services to teachers, pupils, and community groups are the school library and the audio-visual center. The amount and quality of use and preparation of the different types of audio-visual materials in each of these

areas and in the school and the community will depend upon the leadership responsible for the direction of the school's audio-visual program.

Coordination of the Audio-Visual Program

The chief purpose of the audio-visual program is to provide good learning experiences for pupils and adults of the community. According to the Department of Audio-Visual Instruction of the NEA, the persons officially responsible for the audio-visual instructional materials center should be able to render such services as:

1. Stimulating and helping teachers, pupils, and others to make the most of instructional resources
2. Serving as a resource person for curriculum planning groups and other committees
3. Cataloging and organizing materials for use
4. Providing for cooperative exchange of services and materials
5. Assisting in formal and informal in-service education
6. Assisting in the use of instructional equipment
7. Providing mechanical and clerical services
8. Producing simple teaching materials.[2]

The scope of the functions of the center and the quality of the services it renders will be affected by the leadership training and ability of the person who directs it and the amount of time the administration allows for the performance of the various duties of the office. Consequently, it is essential that educators specially qualified and trained in the field of audio-visual materials be appointed as building coordinators of audio-visual programs.

Indiana's Audio-Visual Supervisor's Certificate

In 1951 the Audio-Visual Instruction Directors of Indiana recommended to the Teacher Training and Licensing

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[2] Department of Audio-Visual Instruction of NEA, *Planning Schools for Use of Audio-Visual Materials: No. 3, Audio-Visual Instructional Center*, Department of Audio-Visual Instruction, National Education Association, Washington, D.C., 1954, 80 pp.

Commission a proposed program for an audio-visual supervisor's certificate in Indiana. Because much of the work of the audio-visual director is of a supervisory nature, members of the Commission agreed that the professional education course requirements should parallel those for other administrative and supervisory certificates. The requirements in Indiana for an audio-visual supervisor's certificate, first class, as approved in 1952, revised in 1955, are:

A baccalaureate degree

A valid elementary or secondary teacher certificate or license that carries no deficiencies

Three years of successful experience as principal, supervisor, or teacher within the 10 years preceding application for this certificate

A master's degree, with the graduate credit distributed as follows:

Basic education, 10 to 15 semester hours

At least one course in each of five of the following areas:

	Semester Hours
School administration	2-3
Supervision of instruction	2-3
Educational psychology	2-3
Elementary curriculum	2-3
Secondary curriculum	2-3
Philosophy of education	2-3
Audio-visual education	10-15

A course or courses in each of the following areas:

Selection, circulation, and utilization of audio-visual materials	4-6
Preparation of audio-visual materials (including graphics, filmstrips, and radio programs)	4-6
Administration of audio-visual materials program	2-3
Electives	0-10

The provision for none to 10 hours of electives makes it possible for teachers who will serve as part-time building coordinators to continue graduate work in their teaching areas. Furthermore, because the professional education requirements parallel those of other administrative and supervisory licenses, a student planning to qualify for a certificate as general supervisor, elementary principal, secondary principal, or supervisor of school library and teaching materials can, through a careful planning of courses, qualify also for the audio-visual supervisor's certificate by taking an additional two or three courses in audio-visual education.

Indiana State Board of Education Standards for Audio-Visual Education

The Commission on General Education of the State Board of Education is responsible for the establishment and application of standards for the classification and commission of schools in Indiana. The rules provide for the certification of four classes of elementary and secondary schools: (1) certified, (2) continuous commission, (3) first class commission, and (4) special first class commission. The Commission has recently adopted for inclusion in standards for the certification of schools for the continuous or higher commission the regulation that an audio-visual education program shall be in operation and that the director of this program shall be professionally trained and fitted and shall have had at least five semester hours or the equivalent of audio-visual education courses. Over 1,500 schools in Indiana enrolling approximately 85 per cent of the pupils will be affected by this rule.

The Commission also adopted the following rule on the per pupil expenditure for library books and audio-visual materials:

> The school shall spend at least $1.25 per pupil enrolled each school year for approved and new library books and audio-visual instructional materials. However, no school shall spend less than $100.00 each school year for these purposes. No part of this sum shall be spent for equipment; examples: projectors, shelving, etc.
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> To receive an initial certified certificate, a school must have spent at least $3.75 per pupil enrolled for approved and new library books and audio-visual instructional materials, but not less than a

total of $500.00 for these purposes. No part of this sum shall be spent for equipment; examples: projectors, shelving, etc.

Expenditures required for other types of commissions are:

	Continuous	*First class*	*Special first class*
Per pupil expenditure	$ 1.50	$ 2.00	$ 2.50
Minimum annual expenditure	150.00	200.00	500.00
Initial per pupil expenditure	3.75	3.75	3.75
Initial total expenditure	$1,200.00	$2,000.00	$5,000.00

It is apparent that in over 1,500 schools the rules concerning the appointment of a director who has had five semester hours of audio-visual education and a stated minimum expenditure by all schools for library books and audio-visual materials will greatly expand audio-visual education in the schools of Indiana and will create a demand for a large number of audio-visual building coordinators.

Sources of Audio-Visual Building Coordinators

As has been indicated, over 1,500 schools in Indiana will be appointing an audio-visual building coordinator who has had a minimum of five semester hours of audio-visual education. An important source of potential personnel is the large number of teachers who have completed requirements for an administrative position.

During 1954-1955 the Indiana State Department of Education Division of Teacher Training and Licensing issued over 700 administrative and supervisory certificates classified as follows:

Position	*Number*
Superintendents	160
Secondary principals	259
Elementary principals	194
General supervisors	98
Total	711

There are over 1,600 administrative and general supervisory positions in Indiana. In 1953-1954 they were classified as follows:

Position		*Number*
City and town superintendents		169
County superintendents		92
Secondary school principals		752
Elementary principals with eight or more teachers		623
General supervisors	(approximately)	40
Total	(approximately)	1,676

According to the best available information, the average annual turnover of Indiana school administrators and supervisors is less than 15 per cent. Probably over one half of this turnover is represented by transfers from one position to another for various reasons. For example, a school superintendent in a small town obtains a superintendency in a larger city and is succeeded in his former position by the local high school principal. The best available estimates indicate that the average annual demand for new administrators and supervisors is less than 10 per cent. Consequently it is likely that fewer than 200 of the 711 teachers who obtained administrative and general supervisory certificates during the past year will move to administrative positions during the forthcoming year. In addition to those who were issued certificates, a large number qualified but did not apply for the certificate because an administrative position was not available. During the past several years a great many more administrators have been trained than are needed to fulfill the available positions, with the result that there may be in Indiana over 2,000 classroom teachers who have completed all requirements for an administrative or supervisory certificate.

Many of these teachers will welcome appointment as part-time audio-visual building coordinators with the opportunity to work with fellow teachers, pupils, and community groups in the use and preparation of audio-visual materials. Nearly all of these teachers have completed graduate courses in school administration, curriculum, supervision, and educational psychology and philosophy which are required for an audio-visual supervisor's certificate. Also, many of the teachers have had one or more courses in audio-visual education and will be willing to take the additional courses required for certification.

In some schools a building coordinator who holds the audio-visual supervisor's certificate will be given an additional salary increment. Moreover, service as a building coordinator represents a most valuable experience for those who hope eventually to obtain a position as a principal, general supervisor, curriculum director, or school system director of audio-visual materials.

Some may feel that the position of audio-visual coordinator can or should be filled by a school librarian. The school library field in Indiana, however, is confronted not only with a serious shortage of librarians but also with the fact that a number of persons in school library positions are inadequately trained. A recent report from the State Department of Public Instruction indicates that 236 of 800 school librarians in Indiana have had no work in library science. Sixty-one have had between one and seven semester hours, and 52 have had between eight and 15 semester hours.[3]

The first responsibility of the large number of librarians who have had little or no work in library science is to complete the requirements for a school librarian's certificate. There will be some certificated librarians who will have taken or will later take courses in audio-visual education. These librarians who are qualified in the audio-visual field and who are interested in directing the audio-visual program in addition to serving as the school librarian should be provided with the time and clerical assistance necessary to handle both programs successfully.

There will always be some librarians who will give outstanding service in both the audio-visual and the school library fields. However, the experience to date indicates that only a limited number will complete a training program in the audio-visual field. Only an occasional library science student at Indiana University takes the program of courses required for certification as an audio-visual supervisor. Furthermore, an increasing number of school superintendents and principals are interested in expanding school library

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[3] Whitenack, Carolyn, and Phillips, Beeman N., *Professional Status of School Library Personnel in Indiana*, Indiana Research Bulletin, vol. 2, no. 3, Indiana State Department of Public Instruction, Indianapolis, April, 1955, 6 pp., mim.

services. Teachers need more help in the selection and organization of reference materials. Pupils need additional opportunities for either guided or free reading of all types of good books, magazines, newspapers, and other printed materials. Also, some principals believe that the librarian should assume considerable responsibility for the school's remedial reading program. With an expanded library science program in the area of printed materials, it is unlikely that many librarians who assume responsibility for the reading program will have the time to direct the school's audio-visual program.

Planning the School's Audio-Visual Program

Because of the surplus of school administrators and general supervisors and the shortage of qualified school librarians in Indiana, it appears that, for the present at least, most schools will have both a librarian and an audio-visual coordinator. This will probably be true even in the case of the small school, even though some school librarians would argue that, in the case of the teacher-librarian who devotes three periods to library work and three periods to teaching English, it would be preferable to combine library and audio-visual and to permit the English teacher to handle both types of materials on a full-time basis. On the other hand, most audio-visual leaders believe that, rather than ask an English teacher to take over an audio-visual materials program for which he has no interest, aptitude, or training, it is better to release for three periods a day another teacher who is interested in audio-visual education and either has completed or is planning to complete requirements for the audio-visual supervisor's certificate. The cost to the school will not be any greater for half-time positions in a program of instructional materials coordinated at the principal than for one full-time person in an integrated program. The two half-time people, each with an interest and training in his respective area, will greatly enhance the possibilities of a good program in both the school library and the audio-visual fields. Under the circumstances, therefore, it is recommended that architects and school administrators responsible for the planning of the school buildings include space and facilities for a separate audio-visual instructional materials center.

The minimum space recommended for the center is 375 square feet for a school of less than 10 teachers, 750 square feet for a school of 10 to 25 teachers, and 1,500 square feet for one of 26 to 50 teachers. Included in this area and adapted to the particular needs of the school or community and the design of the building would be such equipment and facilities as:

1. Desk space for audio-visual coordinator and students responsible for the scheduling of materials and equipment
2. Large legal size file cabinet with four drawers for flat pictures
3. Cabinets with shallow drawers for maps, charts, and larger pictures
4. Cabinets for filmstrips, slides, and other transparencies
5. Cabinets for records, tape recordings, and motion pictures
6. Adjustable shelving for books and pamphlets
7. Storage facilities for equipment, screens, and such things as shipping cases, reels, and cans
8. Sink with drainboard and faucets for hot and cold water
9. Photographic safelight over sink and work table for the production of inexpensive audio-visual materials such as maps, charts, posters, graphs, and pictures for projected and non-projected use
10. Facilities for previewing of films and filmstrips and listening to recordings by a small group or by individuals
11. Full control of light to complete darkness with forced mechanical ventilation or air conditioning
12. Acoustical treatment necessary to insure good recording and reproduction of speech and music.

It is recommended that the audio-visual center be placed immediately adjacent to the school library or the principal's office. This will facilitate the sharing of a general reception and office area, clerical staff, and a telephone. An adult will usually be available to assume responsibility for the supervision of student assistants at times when the building coordinator is visiting teachers, attending meetings, previewing new materials, or teaching. Teachers can leave requests and pick up and return materials and equipment at their con-

venience. Also, joint space can be provided for multiple use by the audio-visual coordinator and other school personnel. For example, with the limited amount of space recommended for the center, other rooms will have to be scheduled for such activities as preview of materials by teachers and in-service training meetings.

The audio-visual coordinator and the school librarian, together with the principal and teacher committee who participate in the evaluation and selection of textbook, audio-visual, and school library materials make up the official personnel responsible for the school's instructional materials program. The activities of the different personnel may be coordinated by the principal, or the principal may appoint the person who is best qualified to serve as the director of the instructional materials program. This approach to the instructional materials program makes it possible to employ on either an extracurricular, part-time, or full-time basis a professional staff member who has had experience and specialized training in the evaluation, selection, organization, administration, use, and preparation of all types of audio-visual instructional materials.

LIGHTING THE AUDIO-VISUAL CLASSROOM

Carl J. Allen

One of the significant changes occurring in education is the increased use of audio-visual projected material. This greater use of audio-visual material is partly due to the outstanding success that the Armed Forces have had with this method of education. The extent to which audio-visual material has increased is indicated by surveys which show that six times as many educational films are being used in schools today as were used in 1940. (See Figure 1.) In the college

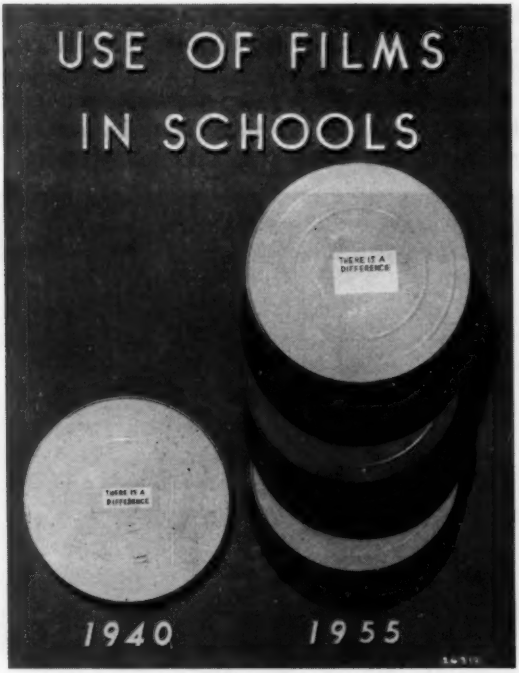


Figure 1
Use of Educational Films Has Increased Six Times Since 1940

field it is estimated that ten times as many educational films and audio-visual presentations are being used as were used 15 years ago.

Significant improvements have been made in the efficiency of lamps, the performance of projectors, and the reflectance characteristic of screens. This has led to the generally held belief that daylight projection is possible and that it is not necessary to darken classrooms. This in turn has led to the condition that most new schools are turned over to the use of the teachers without any provisions being provided for darkening the classrooms. A very prevalent complaint from teachers is that it is difficult to show audio-visual presentations in these rooms because of the great amount of stray daylight which falls on the screen. It is possible with considerable daylight in a room to satisfactorily project black and white line drawings with high output slide projectors, using special directional screens if one views the image from the projector position. However, if a typical colored slide is used in the same projector and viewed from one of the side seats, the results can be entirely unsatisfactory. The accompanying illustration, Figure 2, shows a situation that can

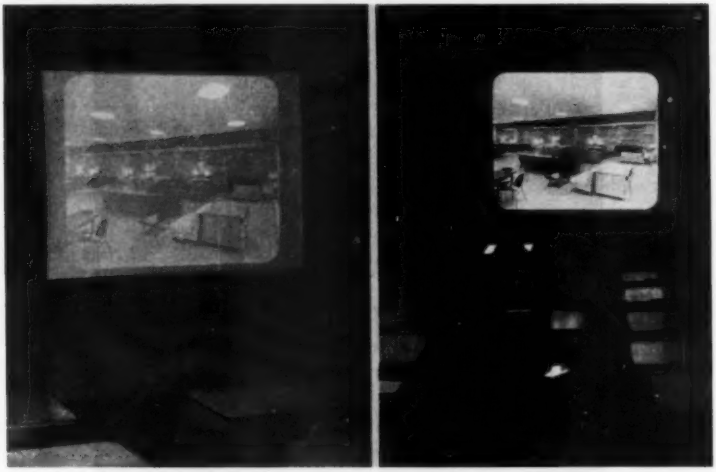


Figure 2

A Student Seated to One Side of the Projector Does Not See as Brilliant a Picture on a Beaded Screen as Does the Teacher Standing Beside the Projector

occur when Johnny, sitting over by the windows, tells the teacher that he can not see the picture on the screen. The teacher, viewing the same slide from beside the projector, can

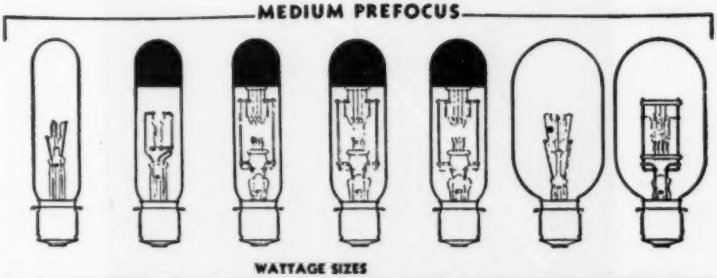
not understand this, as she is seeing a very sharp and brilliant picture.

In order fully to understand the problem of audio-visual projection techniques, it is necessary to understand the limitations and capabilities of modern projection lamps, projectors, and screens, as well as the importance of proper room darkening and room lighting. The goal of room darkening is not to provide black-out, but rather dim-out conditions. The room should be clothed in a soft blanket of subdued illumination, properly balanced so that seeing is comfortable and concentration on the screen is enhanced.

It is generally conceded that audio-visual presentations should be conducted in the classroom and that the auditorium or special audio-visual room should be used only for very long programs or for large groups. In many of the modern auditoriums there are no windows and the darkening problem does not exist, but in classrooms a dim-out daylight control is decidedly necessary.

Projection Lamps

Part of the improvement in modern projection lamps has come about from a projection lamp standardization program.



WATTAGE SIZES						
200	300	500	750	1000	500	1000
PROJECTOR TYPES						
MIN. SLIDE and 16-mm. MOTION PICTURE	8-mm. and 16-mm. MOTION PICTURE MIN. SLIDE	8-mm. and 16-mm. MOTION PICTURE	16-mm. MOTION PICTURE	16-mm. MOTION PICTURE	STEREOPTICON 35-mm. PORTABLE MOTION PICTURE	35-mm. SEMI-PORT MOTION PICTURE
VENTILATION RECOMMENDED						
NATURAL	MODERATE FORCED	HIGH DEGREE FORCED	HIGH DEGREE FORCED	HIGH DEGREE FORCED	NATURAL	HIGH DEGREE FORCED

Figure 3

Seven Lamps That Meet Requirements of 80 Per Cent of Modern Projectors Used in Schools

This program has reduced the number of commonly used projection lamps, such as are used in school projectors, from over 100 types down to seven lamps. The seven lamps which are shown in Figure 3 will lamp at least 80 per cent of the modern projectors used in schools. This standardization means, for one thing, that fewer lamps are necessary in the audio-visual center stock room. It also means better lamps, as manufacturing facilities can concentrate on the less diversified production and the lamp's quality is improved by better quality control.

Only those lamps for which a projector is specifically designed should be used in that projector. The limitations of the optical and ventilation system of the projector limits the wattage of the lamp that can be used in a projector. The curve, Figure 4, shows that increasing the wattage of a lamp past a certain point may not significantly increase screen illumination. This same increase, however, may seriously overtax the ventilation system and cause trouble from excess heat.

Because projection lamps operate at high efficiencies, the temperature of the filaments in most cases is within a few hundred degrees of the melting point of tungsten. The typical

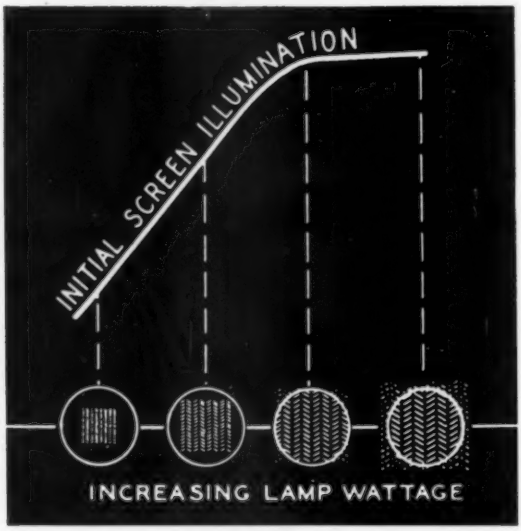


Figure 4
Effect of Increasing Lamp Wattage on Screen Illumination

projection lamp currently used has a 25-hour life. The 10-hour life lamp will deliver from 15 to 25 per cent more light to the screen than the 25-hour life lamp. When comparing projectors, one should be careful that the lamps are of the same wattage, same life rating, and same rated voltage. Variation in rated voltage and difference in life rating can result in a difference of over 50 per cent in light output from two projection lamps, both rated at the same wattage. (For example, a 10-hour life 750-watt lamp of rated 115 volts when operated on overvoltage on a 120-volt line voltage will give a light output of approximately 27,500 lumens. A 25-hour life 750-watt lamp with a rated voltage of 125 volts and operated undervoltage on a 120-volt line voltage will give a light output of 18,000 lumens. Within a range of about ± 10 volts from rated voltage, the light output of incandescent projection lamps varies approximately three per cent with each one per cent change in voltage.)

It is seen from the above that projectors must be equipped with lamps of the proper wattage, voltage, and filament configuration. Information regarding the proper lamp or lamps which should be used in a projector is available from the manufacturer. Lamp manufacturers also have publications, *Lamps for Picture Projectors,* which list the specific lamps to be used for all commonly used projectors.

Projectors

The most commonly used projector is a 16 mm. sound projector. The obvious reason for this is that more educational material is available on 16 mm. sound film than on any other film medium. The next most commonly used projector is the 2″ x 2″ projector which also takes 35 mm. slides and filmstrips. In addition to these two, there are four other types of projectors which are useful and very commonly used in schools: the 3¼″ x 4″ projector, the opaque projector, the overhead projector, and the micro projector. All of these projectors are illustrated in Figure 5, which shows also what one survey indicated to be an "ideal" assortment of projectors for use in schools. While modern projectors are very effective in projecting clear and brilliant film images, they are not outstandingly efficient from the standpoint of utilization of the

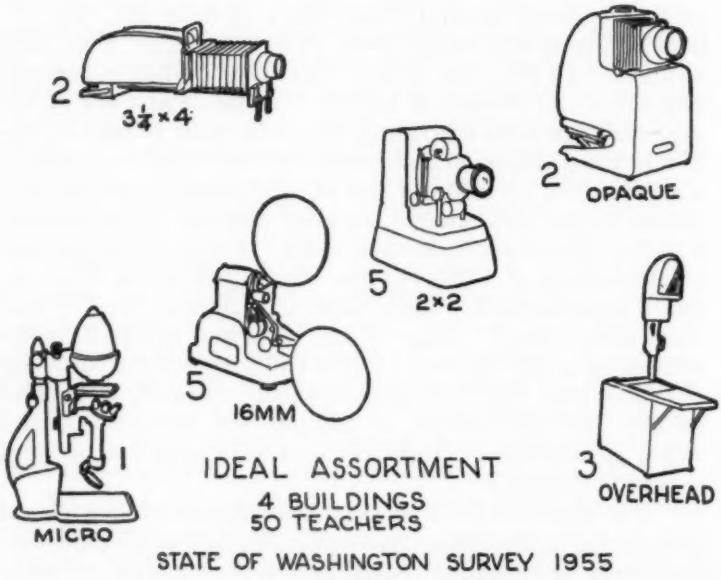


Figure 5
Ideal Assortment of Projection Equipment for School Use, as Determined by One Survey

light available from the lamp. This is shown by the illustration of the 16 mm. projector, which indicates that only 1½ to 2 per cent of the light of the lamp actually reaches the screen. The 2″ x 2″ and 3¼″ x 4″ projectors have approximately three times this efficiency, because they do not need shutters and the aperture opening is not as restricted as the 16 mm. aperture opening. (See Figure 6.) The opaque projector is the lowest in efficiency, as the light of the lamp must be reflected off a diffused reflecting surface; for example, the page of a book. In all the other projectors the light from the filament of the lamp is directed by the lens system through a transparent medium of varying density or color.

The relative approximate abilities of various common types of projectors to produce illumination on the screen is indicated in Table 1. The screen brightness in each of these cases was obtained by setting up each projector so that it would project about the same sized image, 3′9″ x 5′. The screen illumination was measured by a sensitive light meter

TABLE 1. SCREEN ILLUMINATION WITH VARIOUS TYPICAL PROJECTORS*

Projector type	Lens	Lamp	Screen illumination (footcandles)
3¼"x4"	4$\frac{3}{16}$" dia., 18" E.F.	750W	38
3¼"x4"	2⅝" dia., 16" E.F.	750W	24
3¼"x4"	2⅝" dia., 16" E.F.	500W	18
3¼"x4"	2⅝" dia., 16" E.F.	300W	9
2"x2"	f 2.3, 7½" E.F.	750W	60
2"x2"	f 3.5, 5" E.F.	300W	10
16 mm.	f 1.6, 2" E.F.	1,000W	10
16 mm.	f 1.6, 2" E.F.	750W	8
16 mm.	f 1.6, 2" E.F.	500W	6
Opaque†	2½" dia., 18" E.F.	500W	0.5

* No film or slide was in the projector. (Projected image size, 3'4"x4'6".)
† With 80 per cent reflectance white card in the opaque projector. (Projected image size, 3'x3'.)

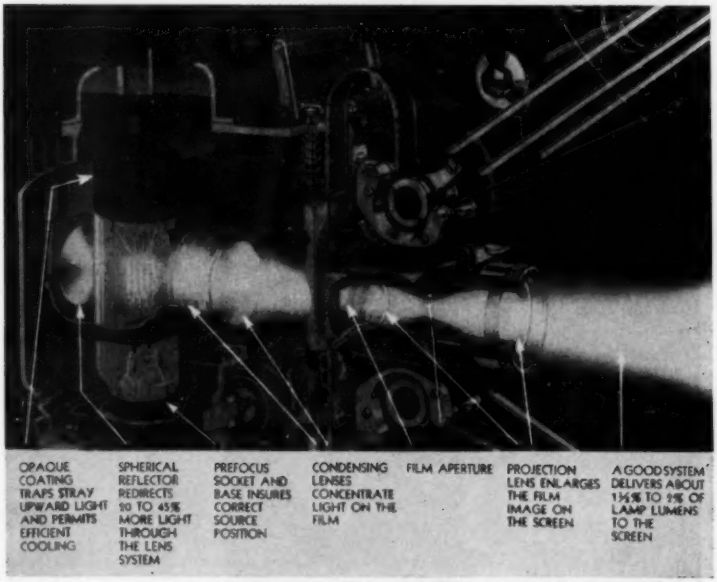

OPAQUE COATING TRAPS STRAY UPWARD LIGHT AND PERMITS EFFICIENT COOLING
SPHERICAL REFLECTOR REDIRECTS 10 TO 45% MORE LIGHT THROUGH THE LENS SYSTEM
PREFOCUS SOCKET AND BASE INSURES CORRECT SOURCE POSITION
CONDENSING LENSES CONCENTRATE LIGHT ON THE FILM
FILM APERTURE
PROJECTION LENS ENLARGES THE FILM IMAGE ON THE SCREEN
A GOOD SYSTEM DELIVERS ABOUT 1½% TO 2% OF LAMP LUMENS TO THE SCREEN

Figure 6

Low Efficiency of Projectors—1½ to 2 Per Cent in the Case of 16 mm. Projectors

located at the center of the screen. From this table it can be seen that a considerable amount of stray light may be permissible when using a large objective lens 3¼" x 4" projector, whereas practically no stray light is desirable when material is being projected by an opaque projector. The ratios of the screen brightness for these two projectors when the same wattage lamp is used in both is of the order of 36 to 1.

Over the years projectors have increased significantly in efficiency due to better optical systems, coated lenses, more efficient shutters, and improved efficiency projection lamps. Even with these gains in screen brightness, one very seldom hears a remark that the projected image is too bright. The general complaint is that stray illumination on the screen washes out the details of the projected picture.

Screens

There are three basic types of reflected light screens which are in common use today: The white matte screen, the processed metallic screen, and the beaded glass screen. Each has its use and, if they are not fully understood, the condition can easily arise that was described earlier, when the teacher sees a very acceptable picture and Johnny sitting a few feet from her complains that he can hardly see the picture.

Figure 7 is a close-up view of the three types of screens. In Figure 8 is shown a photographic comparison of the brightness one sees from the position of the projector, 0° view-

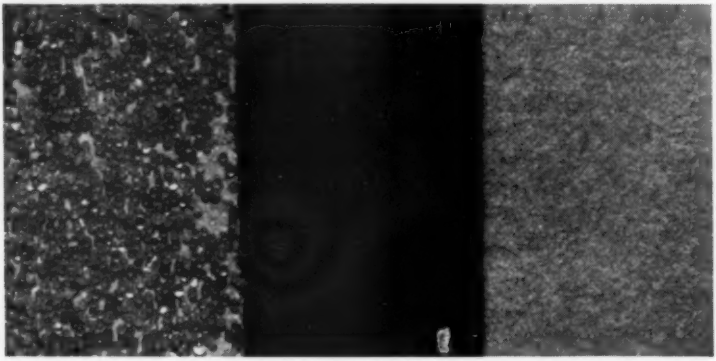


Figure 7
Close-up of Glass Beaded, Processed Metallic, and Matte White Screens

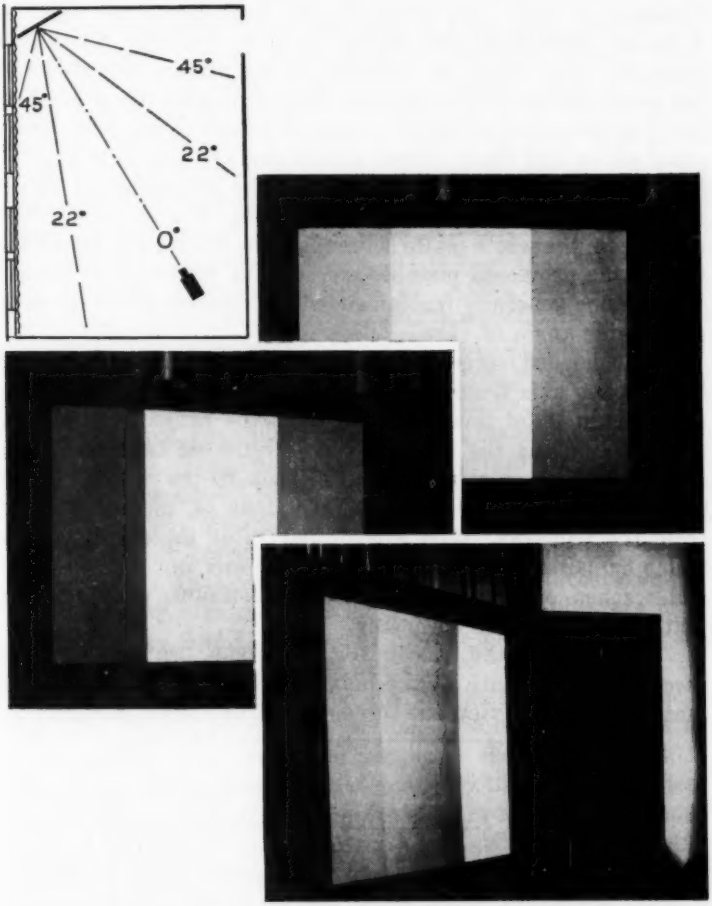


Figure 8

Change in Brightness of a Demonstration Three-Part Screen (Left to Right—Beaded, Metallic, and Matte) as Viewed from the Projector Position, 0°, 22°, and 45°

ing; from a position slightly to one side, 22° viewing; and from a third position at a rather wide angle, 45° viewing. The drawing showing these angles has been superimposed on the floor plan of a typical classroom in order to show that there are certain seats in a classroom which do not give satisfactory viewing conditions with certain types of screen. The processed metallic screen is designed to reflect the light within

a relatively small vertical angle, but to disperse the light in a rather wide horizontal angle. This is desirable when one considers that, from the position of the screen, the students are generally seated in a pattern shaped roughly like a piece of pie. The processed metallic screens, available in specially processed silver and finely ribbed aluminum, are available only in flat panels. The beaded screens have the advantage of being more portable, since they can be rolled up. For widest picture projection, the white matte screen is best. Before the introduction of the processed metallic screens, the white matte screen was the one generally recommended for classroom use because of its wide angle of view.

The beaded screen has the property of directing light back on the axis from which the light came originally. Thus the most brilliant image is seen from the projector position. Stray light from the window also is reflected back on itself, and thus someone seated with his back to the windows will be disturbed the most by the reflections of the stray light from the windows. It is a combination of these two effects which explains why the picture that Johnny saw was so faint and washed out as compared to the brilliant, clear picture that the teacher was observing.

The size of the screen for classroom use is generally specified as one sixth of the maximum viewing distance that that person might view the screen. Thus, as shown in Figure 9,

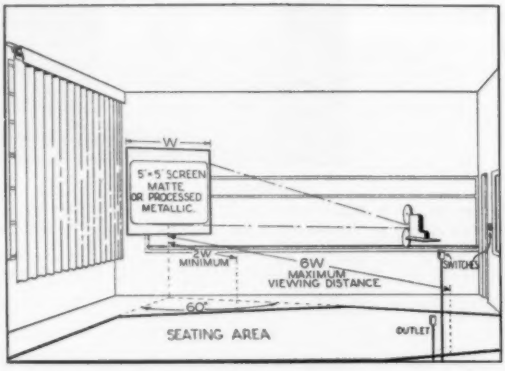


Figure 9

Relationships of Projector and Seating Area When Using a Matte White Screen in a Classroom (Relationships Will Hold Also for Processed Metallic Screens)

a screen of 5′ width is proper for typical classroom projection. Usually a square screen is suggested in order that horizontally and vertically framed slides may be projected equally well. This ratio of one sixth is based upon consideration of seeing small details in the screen. When there is no small detail such as, for example, a pictorial motion picture, this maximum viewing distance can be somewhat increased. In some classrooms 30″ screens are used and the students are seated closer to the screen. One natural advantage of the small screen is that significantly higher brightnesses can be obtained. For example, the brightness of a 30″ width screen will have four times the brightness of a 5′ width screen when the same amount of light is projected upon both. This increase is inversely proportional to areas of the projected image. There is a very common practice, although not necessarily condoned, that TV screens are being observed at much greater distances than six times the screen width. It is important to note that a TV screen may have 10 to 15 times the brightness of a typically projected 16 mm. motion picture. This partly accounts for the greater amount of room illumination that can be permitted with television as compared to motion picture projection. Another reason is that many of the TV tubes are made of black glass, and the reflected light is partly absorbed and not reflected to dilute the TV image.

One projection scheme which has met with fair success has been the use of rear projection. A schematic illustration of a portable rear projection system is shown in Figure 10. The size of the enclosing box is generally limited by the clearance width of typical classroom doors through which it must pass. Like the TV screen, much of the stray light which is incident on the translucent screen is transmitted through the screen and absorbed in the black interior. Older types of translucent screens were rather narrow in their viewing angle, although translucent screens with specially processed surfaces are now available which perform similarly to the processed metallic screens.

Room Darkening

The trend today is not to black-out the classroom for audio-visual presentations but rather to merely dim-out the

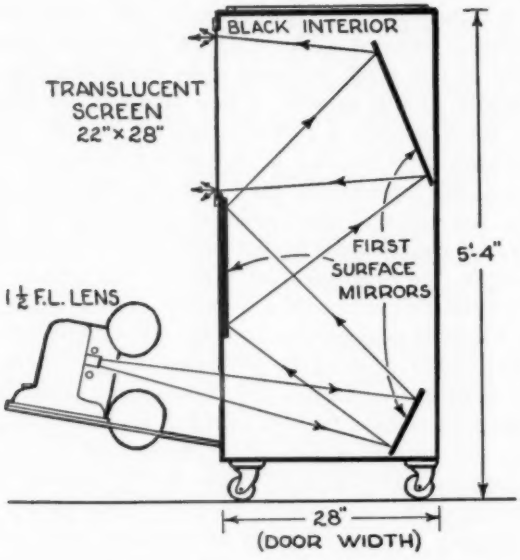


Figure 10
Rear Projection Portable Booths, such as Diagramatically Shown Above, Have Reportedly Been Used with Satisfaction in Southern California Schools

daylight which may be landing on the screen and washing out the projected image. Even with all the improvements in projectors and screens and lamps, it does not take much stray light to dilute typical projected images to the point where they have lost significant detail and become an unsatisfactory visual impression. Table 2 shows the results of one investigation to determine the maximum amount of stray light from the windows which would tend to make a typical projected picture unsatisfactory. The criterion used by the observers was that the picture was unsatisfactory if significant details, which were clearly present under darkened conditions, were lost when the stray light was excessive. The test slide which was used was a typical interior scene and was hand-colored. This slide is shown in Figure 11. The exact maximum amount of stray light naturally will vary widely with various types of projected material. A four-part slide shown in Figure 12

TABLE 2. PERMISSIBLE STRAY LIGHT ON BEADED SCREEN FROM WINDOW AREA[1]

Lamp size in watts	Screen illumination in footcandles	Screen brightness in footlamberts at various degrees from projector-screen axis		Maximum permissible stray illumination on screen in footcandles[2]	
		0°	22°	0°	22°
750	24	90	20	25	6
500	18	70	15	18	4
300	9	35	7	10	2
200	4	15	3	5	1
500[3]	0.5	2	0.5	2	0.25

[1] Projector: 3¼"x4" 2 5/8" Dia. Lens, 16" E.F. (Projected image: 3'4"x4'6".)

[2] Hand colored slide of light colored interior scene in projector.

[3] Opaque projector with white card in projector for screen brightness values and a photograph in projector for stray light evaluation.

was also used. One section was an Ektachrome slide, one a hand-colored slide, one a black and white photographic slide, and the last a black and white line drawing. The three photographic slides showed no significant difference in the amount of stray light. With a good projector the black and white line

Figure 11

Test Slide Used in Experiment to Determine Maximum Permissible Stray Light on Screen

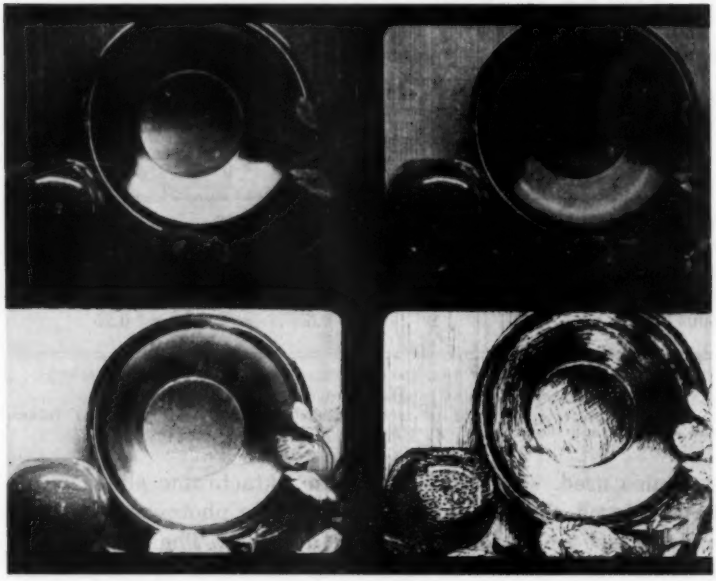


Figure 12

Test Slide: Upper Left, Ektachrome; Upper Right, Hand Colored; Lower Left, Black and White Photograph; and Lower Right, Black and White Line Drawing

drawing slide was still reasonably acceptable with 100 footcandles of stray light on the screen.

One of the principal problems in specifying the amount of darkening necessary for satisfactory projection is the great variation normally encountered in daylight. For example, on a very good sunlit day the outdoor illumination may be 10,000 footcandles. On a dark, rainy day, the illumination may drop to only 100 footcandles. Daylight projection can be very satisfactory if a black and white line drawing is being projected, if the observer is near the projector axis, if the day is not specifically brilliant, and if there is no direct sunlight on the windows. When the sun is on the windows, even with typical roller shades drawn, and a fairly dark-colored scene is being observed from a position somewhat off of the projector axis, the conditions can be entirely unsatisfactory. Under these conditions it is desirable to block out nearly all of the stray light which may fall on the screen. (See Figures 13, 14, and 15.)

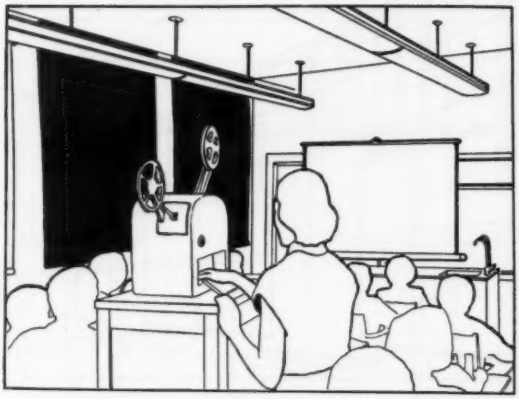


Figure 13
Roller Shade with Six-Inch Minimum Overhang—the Simplest Answer for Darkening Individual Windows

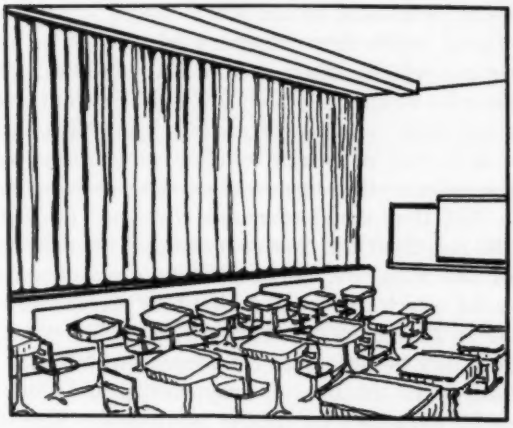


Figure 14
Draperies Which Can Be Pulled over the Windows—a Very Satisfactory Method of Room Darkening

The simplest answer when individual windows are concerned is the use of roller shades of opaque material which will overlap the windows by at least 6″. While these shades are usually black, they need not be if they are essentially opaque. They may be any light color which harmonizes with the room interior.

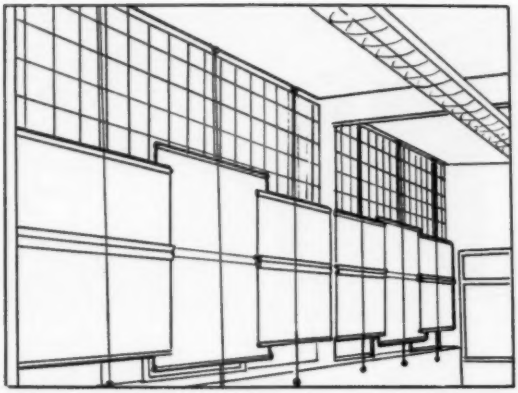


Figure 15
Roller Shades on Specially Designed Brackets, Mounted Between Glass Block and Vision Strip (One Set Pulls Upward, the Other Downward)

The room darkening device which seems to have met with the most favor is the draw drapery which can be pulled on curtain tracks over the entire face of the windows. There are plastic draperies available which are fire resistent and which have excellent wear and tear resistent properties. Draperies work especially well with unit window ventilators located beneath the windows. One basic reason why the draperies are popular is that they can be brought into use as fast as one can walk the length of the classroom to pull the draperies over the face of the windows. Draperies have also been used on curtain tracks which are located about 18″ from the windows with a foot or 18 inches of clearance from the floor, so that the windows may be left open for some ventilation.

In addition to the use of draperies, glass block lighted rooms may be darkened by double hung roller shades which are mounted at the division between the glass block area and the vision strip. One set of roller shades may be pulled up over the glass blocks and the other set may be pulled down over the vision strip.

Where complete darkening is desired, roller shades should be confined in light-tight side and bottom channels as shown in Figure 16. In lecture rooms where darkening is required a good part of the time, roller shades are frequently operated by electric motors controlled with limit switches. Skylights

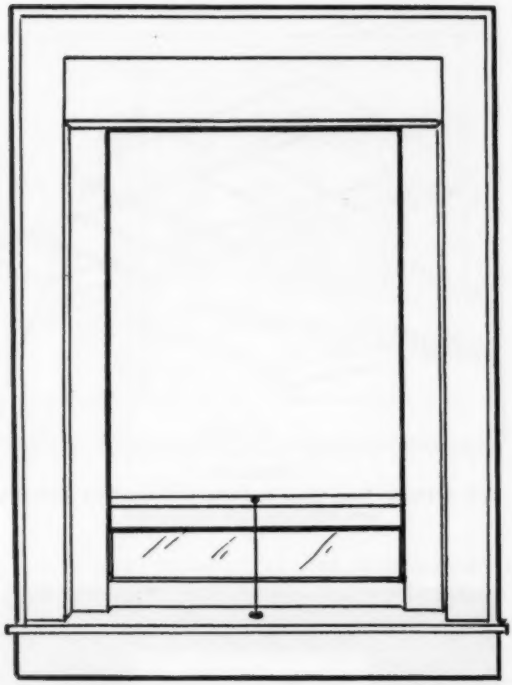


Figure 16
For Complete Room Darkening, Roller Shade Confined in Light-Tight Side Channels

may be darkened by roller shades which are held close to the opening by tight wires over which the roller shade slides. (See Figure 17.) If the stray light is coming onto the screen from the side or overhead, its washing out effect may be minimized by means of baffles around the screen. The portable screen shown in Figure 18 is equipped with such baffles.

Recent developments in venetian blinds now make available a blind which closes tight with very little light leakage. When used in conjunction with light-tight side and bottom channels, these full closure venetian blinds could be a very effective means of room darkening. They also serve very well for the purpose of normal daylight brightness control. (See Figure 19.)

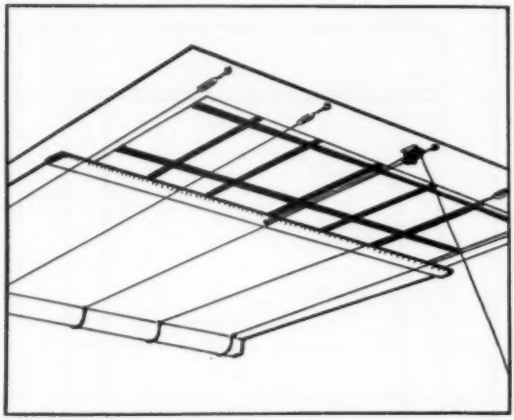


Figure 17
Tight Wires to Help Keep a Skylight Shade from Dropping and Admitting Light at Its Edges

Figure 18
Effect of Stray Light from Either Side or Above Minimized by Baffles Around Screen

Figure 19
Full Closure Venetian Blinds for Room Darkening and Daylight Glare Control

Room Lighting

While it may seem paradoxical that after a room has been darkened the next consideration is to provide light in the room. It is generally agreed that a completely dark surrounding is not comfortable for viewing projected audio-visual material. The contrast between the screen and its surround is too great. On the other hand, too much surrounding light detracts from the projected images and, if it falls on the screen, it dilutes the sharpness of the projected image.

Most existing rooms will have no provisions for dimming the existing lighting system. In this case an indirect light which is part of the projector cart, as shown in Figure 20, may be utilized. The indirect reflector lamp is controlled by a small variable auto-transformer, so that the illumination in the room may be varied from about one footcandle to complete darkness. About one footcandle seems about as much as is normally desired. The exact amount will vary with each type of projection and with the position of the observer with regard to the screen. The double pole double throw switch was incorporated into this design in order to overcome the awkward situation when there is no light in the room between the time the room lighting is switched off and the time the teacher turns on the projector. With the double throw switch

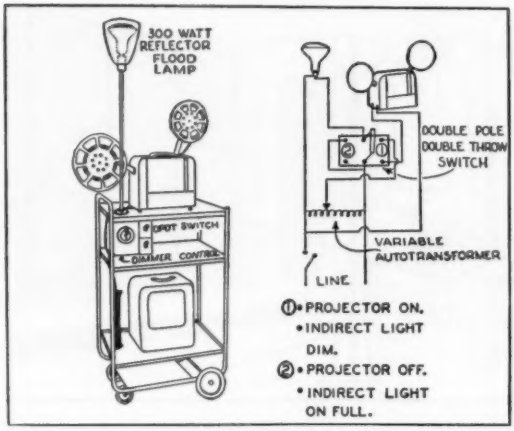


Figure 20

An Indirect Light Which May Be Incorporated as Part of Projection Cart (Operated on a Dimmer, It Provides a Soft Light in Room During Projection)

in one position, the indirect light is on at its full value and the projector is off. When the double throw switch is turned to its other position, the projector is on and the indirect light is on at a subdued level, depending upon the setting of the auto transformer. With this arrangement the lighting in the room may be varied to meet the requirements of the specific type of projection being done.

In new construction, where incandescent lamps are to be used for general lighting, such as in the silvered bowl lighted room in Figure 21, a double pole double throw switch can also be used to provide dim-out lighting by placing two of the rear lamps in series. Series operation of incandescent lamps is equivalent to operating the lamps at 50 per cent of rated voltage, which results in a light output of about 10 per cent of normal light output. Thus, if 30 footcandles are provided in the room when all six lamps are on, about one footcandle (1/3 x 1/10 x 30) is provided when the four front lamps are turned off and the two rear lamps are operated in series. The double pole double throw switch should be conveniently located in the rear wall of the room near the probable projector location.

One audio-visual lighting scheme which has worked out very satisfactorily is a downlighting system illustrated in

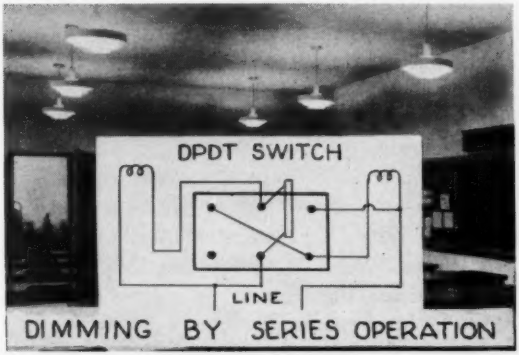
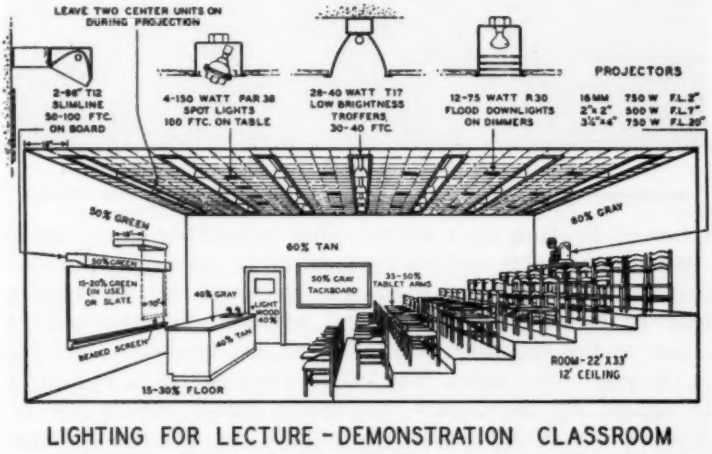


Figure 21
A Low Level of Illumination Which May Be Obtained by Operating Two Incandescent Lamps in Series. (A Double Pole Throw Switch May Be Used to Accomplish This.)

Figure 22, in which the light is confined just over the seating area. In this case, 75-watt R30 reflector lamps when operated at full voltage will provide about 5 to 10 footcandles. This is too much disturbing light for viewing typical projected pictures. The white page of a notebook becomes too bright in


LEAVE TWO CENTER UNITS ON DURING PROJECTION
2-96" T12 SLIMLINE 50-100 FTC. ON BOARD
4-150 WATT PAR 38 SPOT LIGHTS 100 FTC. ON TABLE
28-40 WATT T17 LOW BRIGHTNESS TROFFERS 30-40 FTC.
12-75 WATT R30 FLOOD DOWNLIGHTS ON DIMMERS
PROJECTORS
16MM 750 W FL.8"
2"x2" 500 W FL.7"
3¼"x4" 750 W FL.20"
50% GREEN
60% TAN
60% GRAY
50% GRAY TACKBOARD
33-50% TABLET ARMS
15-20% GREEN (IN USE) OR SLATE
40% GRAY
BEADED SCREEN
15-30% FLOOR
ROOM-22'X33' 12' CEILING

LIGHTING FOR LECTURE-DEMONSTRATION CLASSROOM

Figure 22
Reflector Lamps Concealed in Downlight Units and Operated on a Dimmer to Provide a Low Level of Illumination Without Glare

contrast to the brightness of a typical picture on the screen; and also the full brightness of the lamps, even when fairly well-shielded, produces a feeling of overhead glare under darkened room conditions. When these same lamps are reduced in output by an auto transformer, so that about one footcandle is provided on the desks, then the lighting arrangement is very comfortable from the standpoint of any glare and also from the standpoint of brightness balance of notebook and screen. With this arrangement there is no wash-out effect of stray light on the screen, as the light is confined principally to the seating area.

In many lecture rooms there are no windows, and the two rooms shown in Figures 23 and 24 illustrate common

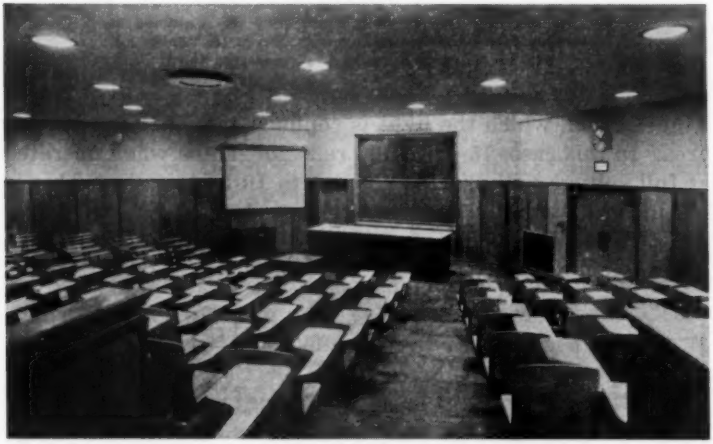


Figure 23
Incandescent Lighting Units Operated on Remote Controlled Motor Driven Dimmers

types of lighting such rooms. One installation uses incandescent downlights and the light output is controlled by motor driven auto-transformer dimmers. The motor driven dimmers may be remotely controlled and operated by push-buttons either at the speaker's position or at the projection location at the rear of the room. The lecture room shown in Figure 24 is lighted by rapid-start fluorescent lamps which can be dimmed by recently developed circuits. The fluorescent lamps in the low brightness etched aluminum troffers in this room are also controlled by motor operated dimmers.

Figure 24
Rapid-Start Fluorescent Lamps, as in These Recessed Troffers, Which May Be Dimmed by Special Circuits

There are occasions when the instructor may wish to write in the dark at the time material is being projected on the screen. This is possible by using a "black light" chalkboard, as shown in Figure 25. The reflector above this custom-built portable chalkboard utilizes a commercially available fluorescent chalkboard lighting reflector. Instead of the regular fluorescent lamp, it is lamped with a 40-watt black light fluorescent lamp equipped with a black light filter. When fluorescent chalks in the various available brilliant colors are used, writing in the dark can be very effective and dramatic.

Preparation of Audio-Visual Material

One additional consideration in the audio-visual picture is the preparation of slide material for good visibility.

Too often when one wishes to illustrate a talk, illustrations in articles or books are copied directly for slide use. This too frequently results in too much and too small detail. The bar chart material shown in Figure 26 is typical of this. Five different researches are summarized on this slide. For study in a book this may not be too much. For flashing on a screen it is too much for the typical audience to grasp easily. In addition, the lettering is so small that the audience has difficulty reading the words from any appreciable viewing distance.

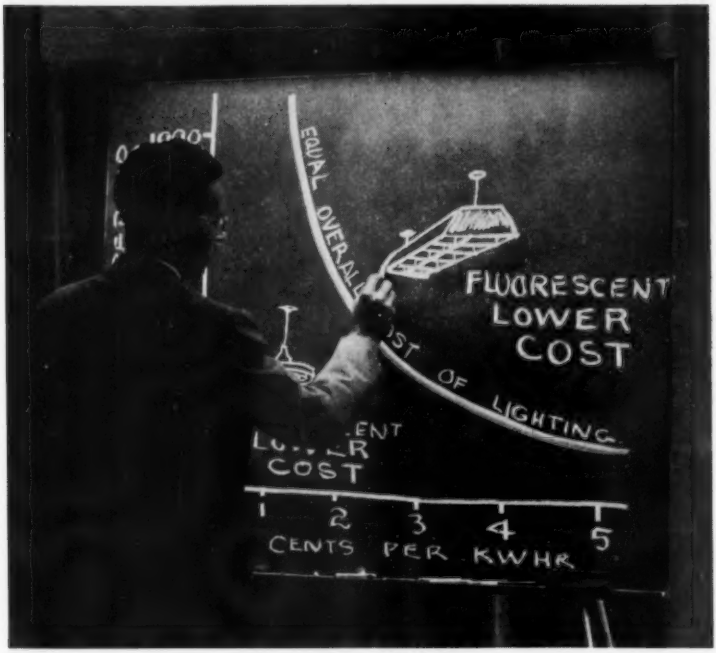


Figure 25
Blacklight Fluorescent Lamps in a Chalkboard Lighting Unit Which Permit Writing in the Dark with Brilliant Color Fluorescent Chalk

When one considers the preparation of material for a slide, one is concerned as to the size of letter that should be used and the thickness of lines if graphs or curves are involved. The information contained in Figure 27 is designed to give guidance in this respect. Letter sizes and line widths are given in terms of height of the illustration. Thus, if the available letter sizes are known, the height of the drawing may be determined. If the size of the drawing is known, then the ratio of letter height to drawing height gives the minimum size letters which should be employed. The smallest lettering ratio of 1/50 of H is based upon a minimum projected letter height of 1″ for each 30′ of viewing distance. The typical AMA eye chart which is used for vision screening is roughly based upon a normal person with 20-20 vision being just able to see letters of 1″ height at 50′. Thus the 1/50 H ratio considers the fact that not everyone has 20-20 vision and

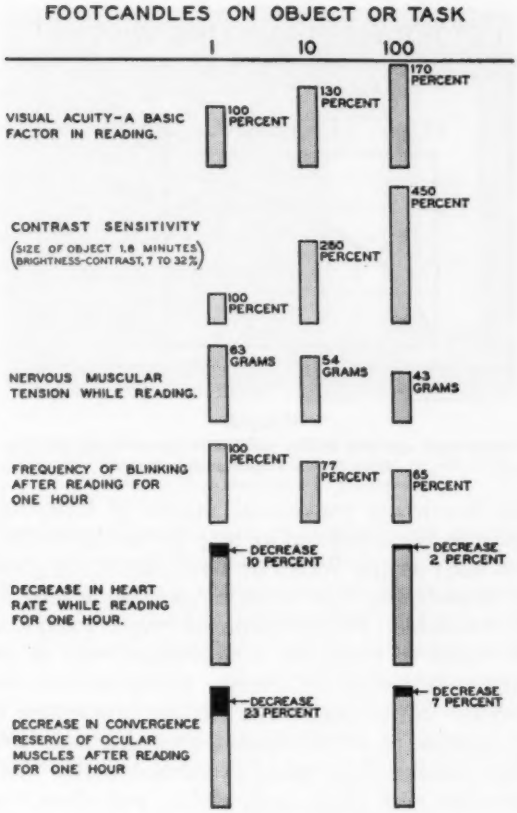


Figure 26

A Slide Made of a Book Illustration Such as This. (The Detail in the Slide Is too Small for the Typical Audience to See When the Slide is Projected.)

for some the size of letters needs to be larger. The assumption is made that a screen width equal to 1/6 the maximum viewing distance will be used during the projection of the material. A convenient means of checking the relative visibility of letter sizes and line widths is to view the drawing or chart at a distance eight times the height of the chart. This is essentially the same formula as viewing the chart at six times the chart's width, as typical slide proportions, width to height, are about 1.25-1.33 to 1.

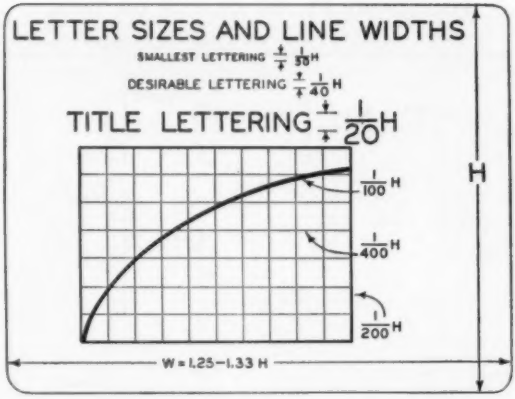


Figure 27
Letter Sizes and Line Widths Which Will Assure Good Visibility Under Typical Projection Conditions

There are many convenient means of lettering charts. Charts may be hand-lettered or may be mechanically lettered by devices such as the Wrico or Leroy lettering guides. For dramatic three-dimensional lettering, molded letters of various styles are available. Pre-cut gummed paper letters, available in a wide range of sizes, are a convenient way of providing good legibility lettering for charts. Under certain conditions the typewriter can be used. The electric typewriter is naturally best because of its controlled pressure and, when used with carbon paper ribbon, gives excellent results. The regular pica typewriter with good black ribbon and clean type gives acceptable lettering. The pica size type on a 5″ x 7″ card will give lettering of minimum acceptable size. If the same sized type is on a 3″ x 4″ card, the size of the resulting letters projected on the screen will give very good visibility for viewing distance of the order of six times the width of the screen.

The slide shown in Figure 28 may be compared with the one shown in Figure 26. It is a redrafting of the same material in a simpler, more easily understood version. This time only one idea was presented. This slide sells itself to the audience. It combines brevity and clarity with dramatic illustrations and color. Audio-visual education, with teaching lessons as represented by this slide, may be relied upon to give impressions that are effective and lasting.

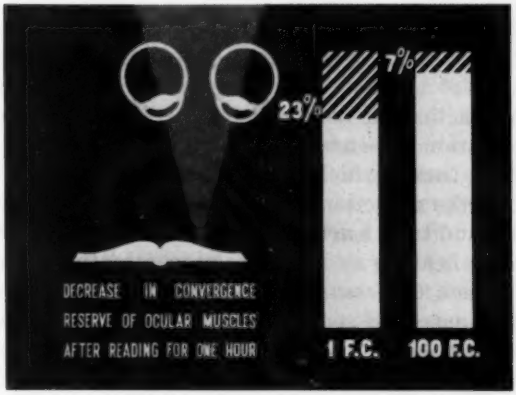


Figure 28
An Example of a High Visibility, High Attention Power Slide. (This Slide May Be Compared with Figure 27, in which five Times as Much Material Was Presented.)

Today suitable equipment is available for making audio-visual teaching an efficient means of education. The various components—projectors, screens, darkening devices, and lighting—however, still need to be coordinated so that a teacher can use audio-visual projection with a minimum of classroom interruption. It might be well to reflect that the teacher-chalkboard combination is a very old but still very effective audio-visual team. If audio-visual projectiopn is to be as long lived and as successful, it, too, must be easy and effective to use.

SOUND CONTROL

Hale J. Sabine

A satisfactory environment for the "audio" part of audio-visual education depends on two aspects of sound control. The first of these, which may be considered as a negative approach, is the reduction or elimination of sounds which may hinder the auditory learning process, either by direct interference with hearing or by distracting attention. This phase may be termed the control of unwanted sound. The second and positive aspect of sound control is to provide satisfactory conditions for communication of audio-educational material or, in other words, of wanted sound. Since audio communication in the educational process is frequently two-way, and since teachers as well as pupils may be subject to distraction or annoyance by unwanted sound, it is important to design sound control measures with the requirements of both in mind.

The general principles of sound control are well outlined in literature[1] available to educators and school planners. In the present discussion these principles will be reviewed briefly, and some practical examples both of effective sound control procedures and of difficulties arising from the omission of such procedures will be cited.

Noise Control by Room Layout

The first point of attack in the control of unwanted sound is to keep sound from traveling from its source to rooms or areas where it does not belong. This type of control logically begins with the location of the school building with respect to outside noise sources. The building site should, if possible, be kept well away from air ports, main line railroads, arterial highways, or heavily traveled city streets, especially those

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[1] Knudsen, V. O., and Harris, C. M., *Acoustical Designing in Architecture*, John Wiley and Sons, Inc., New York, 1950; Bolt, R. H., "Acoustics," in *Music Building, Rooms and Equipment*, ch. 7, Music Educators National Conference, Chicago; *Less Noise, Better Hearing*, The Celotex Corp., Chicago; *Planning Schools for Use of Audio-Visual Materials*, nos. 1, 2, and 3, National Education Association, Washington, D. C.

carrying truck, bus, or street car traffic. If such a location is unavoidable, it must be remembered that, if the windows are of the usual single thickness of glass, by far the greater part of the transmission of noise into the building takes place by this route, even when the windows are closed. Opening the windows for warm weather ventilation of course aggravates the problem. The only effective method of control is the use of double window sash or double panes separated by an air space. The windows should preferably be sealed in place so that they can not be opened, and inside ventilation should be provided. If vision through the windows is not important, but only light is needed, the use of glass block masonry would also be satisfactory and would probably make the windows comparable to the walls in sound isolating efficiency. If only one side of the building is exposed to outside noise, it would generally be sufficient to employ such measures only on that side.

The next step in the control of noise transmission is to consider the locations of noisy rooms in the building in relation to rooms where comparative quiet is necessary. One of the most effective ways of isolating one room from the noise produced in another is to avoid having a common partition, floor, or ceiling between them. This principle may be utilized in a number of ways in designing the layout of the school building. The music rooms, in which the highest sound levels in the entire school may occur, are preferably placed in a separate wing and isolated from classrooms on the same floor by intervening corridors or storage areas. The gymnasium should be similarly isolated, with particular attention being paid to the possibility of impact noise being transmitted through the floor. This problem may be avoided either by having no basement below the gymnasium, or by using the space for storage, utilities, shops, locker rooms, or other functions which are not seriously affected by noise transmission. The same precautions should be taken in the location of shops, both because of the potentially high noise levels and because of the possibility of machinery vibration being transmitted through the floor.

The amount of sound isolation which can be accomplished by means of room layout, however, may be severely limited or even nullified by transmission along corridors and stair

wells. If all of the interior surfaces of a corridor are of highly reflective finish materials, such as concrete, terrazzo, hard plaster, or the metal surfaces of lockers, it is common experience that a sound originating anywhere along the corridor will travel along its entire length with practically undiminished loudness. The corridor, instead of acting as an isolating space, serves as a very efficient conductor of sound over long distances. This situation is of course most troublesome when doors opening onto the corridor are left open for warm weather ventilation. For example, if a sound film is being shown in one classroom and the sound is allowed to escape into the corridor through the open door, the sound entering through the open door of every other classroom on the corridor will be very nearly as loud as if each classroom were immediately adjacent to or across from the one where the sound originates. Any other sound or noise, as from the cafeteria, gymnasium, music room, etc., as well as disturbances due to traffic and activity in the corridor itself, will similarly be delivered to the doors of all of the rooms on the corridor.

The most effective method of reducing corridor transmission, aside from keeping all doors tightly closed and well sealed at all times, is acoustical treatment of the corridor ceilings. The absorbing action of such treatment causes sound to lose energy much more rapidly as it travels along the corridor than is the case with highly reflective surfaces. The net effect is to confine noises entering or originating in the corridor to the vicinity of their source, and to cause the corridor to act more like an isolating than a conducting space.

Sound Insulating Construction

When the program of sound isolation by means of room layout has been carried as far as practicable, attention should next be paid to transmission between adjacent rooms. Before discussing this problem, a word or two of explanation may be helpful. Sound levels are commonly measured and stated in units termed "decibels." Without going into the exact definition of this unit, it may be stated that zero decibels is the level of a sound just barely audible to an unusually sensitive ear, and that 120 decibels (db) is the level of a sound so loud as to cause a sensation in the ear of feeling as well as hearing.

The scale is shown in Figure 1, with estimates of the average levels of a few representative sounds occurring in school buildings. The effectiveness of a partition, floor, or ceiling construction in reducing the transmission of sound through it is termed its "transmission loss" and is defined simply as the number of decibels which a sound loses in being transmitted through the wall. If, for example, a sound of 70 db level strikes a well having a 30 db transmission loss, the level of the transmitted sound will be 40 db, as shown in Figure 2. In estimating the required transmission loss of a wall between two rooms, which can be termed the "source" and "receiving"

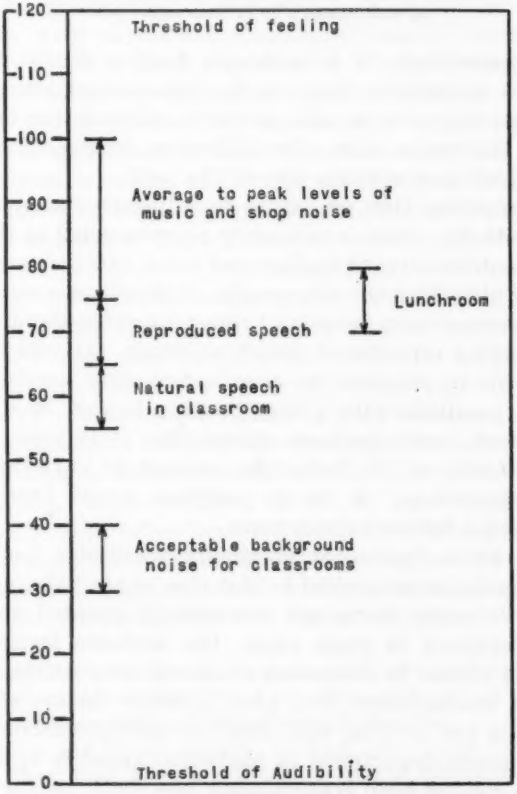

Figure 1
Estimated Decibel Levels of Typical Sounds in School Buildings

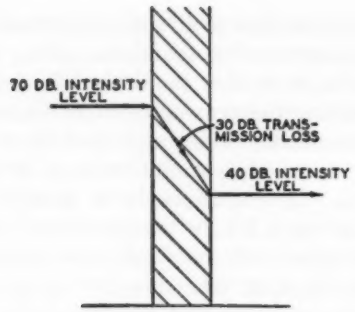

Figure 2
Reduction in Level of Sound Transmitted by Wall Having a 30 db Transmission Loss

rooms, respectively, it is necessary first to decide what the maximum permissible level of the transmitted sound in the receiving room is to be, and second to estimate the maximum level on the source side. The difference between the two is the required transmission loss of the wall.

In applying this procedure to adjacent classrooms, the figure of 40 db, which is commonly recommended as the maximum acceptable level of background noise, may be used for the receiving side. For the source side, it should be assumed that every classroom may be used at times for audio-visual instruction involving reproduced speech or music, for which a level of about 70 db provides the most satisfactory hearing conditions. A partition with a transmission loss of 30 db would be indicated, but experience shows that it is wise to allow a safety factor of 10 db to take account of variations from average conditions. A 40 db partition would therefore be recommended between classrooms.

The 40 db figure for maximum acceptable background noise should also be applied to libraries, study halls, and auditoriums. If noisy rooms are unavoidably situated above, below, or adjacent to these areas, the probable levels on the noisy side should be estimated as closely as possible, and the indicated transmission loss, plus a safety factor, should be provided in the dividing wall, floor, or ceiling construction.

The music department in particular requires special construction having high transmission loss, both because of the high sound levels involved and because the sound of music

where it does not belong is liable to have a distracting effect out of proportion to its actual loudness. The levels of band or orchestra music, or of single instruments in small practice rooms, will vary considerably, but may reach 90 to 100 db a good part of the time. A recent survey of music schools in the south,[2] in which sound transmission through various partition constructions was measured, indicated that a transmission loss of 45 db between practice rooms or between studios was not satisfactory, but that a value of 55 db was acceptable. Constructions of this order of efficiency should be provided wherever it is desired to keep musical interference between adjacent rooms to a minimum.

At the same time, arrangement of corridors, storage spaces, etc., with respect to the high level rooms in the music department can be used to considerable advantage to take the place of special partitions having high transmission loss. The provision of vestibules outside the band, orchestra, or choral rooms, or of extra sets of doors across the corridors at strategic locations, may also be helpful where isolation can not be fully achieved by room layout alone. As mentioned before, acoustical treatment of corridors, vestibules, and other rooms which may function as sound isolators will considerably enhance their value in this respect. The possibility of undesirable transmission from the music department to rooms above and below should also be taken into account and controlled where necessary by adequate floor or ceiling construction.

A large number of partition, floor, and ceiling structures have been tested for transmission loss, and the data are available in standard texts on architectural acoustics and from other sources.[3] Representative values for a few constructions typical of modern school building practice will be given here. Porous concrete block and cinder block are extensively used for partition construction, and can be utilized to provide a wide range of transmission loss values. The most important

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[2] Lane, R. H., and Mikeska, E. E., *Acoustic Requirements of Music School Buildings*, paper presented at the 48th meeting of the Acoustical Society of America, Austin, Texas, November 20, 1954.

[3] Knudsen and Harris, *op. cit.*; Bolt, *op. cit.*; *Sound Insulation of Wall and Floor Constructions*, National Bureau of Standards, Building Materials and Structures Report, no. 144, U. S. Government Printing Office, Washington, D. C.

fact to bear in mind is that, if a partition of one of these materials is left unplastered on both sides, sound waves tend to pass directly through the pores of the material with relatively little attenuation. The amount of penetration, however, varies greatly, depending on the manufacture of the blocks and the resulting degree of porosity. Fine aggregates, large amounts of cement in relation to the aggregate, and, in particular, wet mixes which tend to form an impervious film of cement over the surface during the forming operation, are all helpful in reducing porosity and restricting sound leakage through the material. Test values ranging from 11 to 44 db on unplastered partitions of four-inch and eight-inch thickness have been obtained. In view of this extremely wide variability it is impossible to state a typical or average value. It can only be pointed out that, if 40 db, or even 30 db, is taken as the minimum acceptable transmission loss for a partition between classrooms, unplastered porous concrete block partitions are more than likely to prove unsatisfactory.

The application of plaster to one face effects a tremendous improvement which may be as much as 20 db. The impervious seal effectively blocks direct penetration of sound waves and causes sound to be transmitted by vibrating the wall as a whole, thus allowing the weight of the wall to be effective. Since the sealing of the pores is the important factor, addition of plaster to the second face effects an improvement of only about two or three db in the transmission loss. Four-inch and eight-inch partitions plastered on one or both sides range from 35 to 45 db, and sometimes higher, depending on the weight of the block and the amount of plaster, which renders them generally suitable for use between classrooms. Clay tile and gypsum block partitions plastered on both sides are of about the same order of efficiency. Generally speaking, the thickness of masonry partitions, especially if they are of hollow rather than solid block, has comparatively little effect on transmission loss. Increasing the thickness of any one type from three inches to eight inches accounts for an improvement of not over five or six db.

In order to obtain transmission loss values of the order of 50 to 55 db which are required for partitions between music rooms, it is necessary to use double construction of some type. This may take the form of two free-standing

masonry walls with no connection across the air space except at the edges, or of furred lath and plaster connected to a masonry core on one or both sides by resilient clips which absorb vibration and approach the effectiveness of a completely unbridged air space. Recent field measurements[4] on a partition having a gypsum block core and resilient furred lath and plaster on one side showed a value of 54 db. Resilient furred plaster on both sides, plus furred plywood on both sides, had a transmission loss of 59 db, which was more than adequate.

A type of double construction using porous concrete blocks has proved satisfactory and practical. This consists of a double four-inch wall with the outside faces left unplastered but with a scratch coat of plaster applied to the inner face of one wall before the erection of the second wall. A test value of 57 db was obtained on one construction of this type, using a relatively dense, non-porous block. A more porous block would probably result in somewhat lower values. The addition of plaster to the outside face of the wall having no plaster on the inside face would result in still higher efficiency, which would be less dependent on the porosity of the block.

The over-all sound insulating value of highly efficient partitions between music rooms may be seriously curtailed by doors and observation windows. The heaviest types of standard door when thoroughly gasketed around all edges have a transmission loss of only about 30 db, and special sound insulating doors range from 35 to 40 db. It is found in practice that sound leakage around the edges, even when well adjusted gasketed stops and threshold closers are used, is generally the limiting factor in the over-all efficiency of doors, and that even slightly imperfect closure may cause the actual performance of a door to fall considerably below its rated value. Furthermore, the combined transmission loss of a door set in a wall of higher efficiency will generally be closer to the value of the door than to that of the wall. For example, if a 30 db door is set in a 50 db wall having five times the area of the door, the transmission loss of the combination will be only about 37 db. In general, therefore, it is well to remember

[4] Lane and Mikesa, *op. cit.*

that, if a door occupies more than about five per cent of the area of a wall, it will definitely be the weak link in the combined sound transmission, and that little or nothing is to be gained by making the wall very much more efficient than the door.

The same remarks are applicable to observation windows, which are frequently used between music rooms. However, the attainment of high transmission loss presents less of a practical problem with windows than with doors. Values of 45 to 55 db are readily obtained with double panes of ¼-inch glass. Each pane should be set in rubber gasketing, and the two panes separated as far as possible. When double glazing is set in a double wall, as is normally the case, the structural separation should be maintained through the window frame, as shown in Figure 3. Lining the perimeter of the window

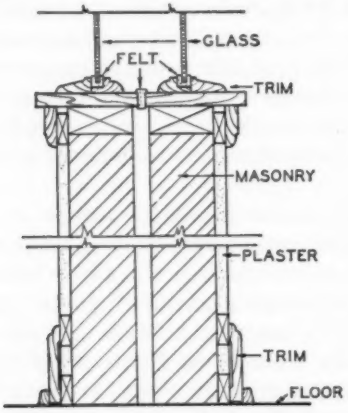

Figure 3
Detail of Sound Insulating Window Construction, Showing Complete Structural Separation of Double Wall

frame between the panes with acoustical material will also add a few db to the efficiency.

The effectiveness of well-built partitions, doors, and windows can also be short-circuited by ventilating ducts. These should be lined with acoustical material, which is available in special forms for this purpose, and they should provide paths not less than 10 feet long between adjoining rooms. An acoustically lined duct having a wide, shallow cross sec-

tion is considerably more effective than one of square cross section of the same area.

Transmission problems through floors and ceilings are generally less severe than in the case of partitions, because of the greater mass and rigidity necessitated by structural requirements. Standard types of concrete floor construction which meet the usual code requirements, such as exposed concrete slab or steel joists with suspended ceiling, have transmission loss values ranging from 45 to 55 db, which is adequate for all normal conditions. In the unusual situations where, for example, it is necessary, in spite of the best planning, to place a library or study hall directly over a shop, where the levels may reach 100 db, special attention must be paid to the floor construction. Transmission loss values of 55 to 60 db may be obtained by the use of special resilient hangers with suspended ceilings. Placing a mineral wool blanket over the suspended ceiling will add a few db. Floating floor construction, which consists of a separate wood or concrete floor resiliently supported over the main floor slab, is also very effective, especially for direct impacts or vibration, but is not always structurally feasible. It should, however, be seriously considered for gymnasiums where the rooms below may be subject to disturbance from the noise of running or ball bouncing.

Reduction of Noise Within Rooms

In addition to problems of noise control involving transmission between rooms, there are certain areas in the school building where unwanted sound may build up to distracting levels within the rooms where they originate. The most intense noise sources are generally to be found in shops, typing classrooms, lunch rooms and cafeterias, and, as mentioned before, corridors. If these spaces are finished throughout with typical highly reflective materials, such as concrete, plaster, glass, etc., which absorb less than about three per cent of the energy of sound waves striking them, the reflection of sound waves back and forth between the room surfaces builds up the level of any noise created in the room to a point much higher than it would be if no reflection took place. While it is not practical, even if it were possible, to eliminate all sound reflec-

tion, the provision of acoustical material on the ceiling areas of most rooms and corridors is sufficient to reduce excessive reflection to the point where most of the noise which one hears is that which travels directly to the ear from its source. Acoustical materials used primarily for noise control should preferably have a noise reduction coefficient of not less than 0.70. This figure represents the fraction of incident sound energy, averaged over the frequency range from 250 to 2,000 cycles per second, which is absorbed by the material. While ceiling treatment alone is generally adequate, additional material on wall areas produces a noticeable improvement in small rooms in which the proportion of ceiling to wall area is correspondingly small, and in high, narrow corridors where the ceiling area is likewise limited.

Classrooms

In considering the control of wanted sound for educational purposes, it must be remembered that a large part of the educational process depends vitally on speech communication. The first and most important factor in providing a favorable acoustical environment is therefore the assurance of satisfactory intelligibility of both natural and reproduced speech. Since most speech communication takes place in the classroom, its requirements will be considered first.

The primary requisites for effortless understanding of speech, assuming normal hearing acuity and reasonably clear diction or distortionless reproduction, are, first, that the loudness level of the speech throughout the room be above a certain minimum; second, that background noise be kept below a certain level; and third, that there be a negligible amount of distortion of the speech sounds by reflection from the room surfaces. The first two of these requirements are to some extent interdependent, in that the speech level should be at least 20 db above that of the background noise to insure the best intelligibility. If the noise level is kept below the previously recommended value of 40 db, the required speech level is 60 db, which is easily produced in a classroom of average size by a teacher with normal voice power, and which is entirely adequate for satisfactory intelligibility. In the case of reproduced speech, there is no limitation on loudness except

for the power capacity of the system, which is normally more than adequate.

It will generally be found that a sound level of 60 to 70 db provides the best listening conditions if background noise is not excessive, and that there is no gain in intelligibility, and possibly a definite loss, if the level is set much higher. There may be an incidental problem, however, in the case of sound motion picture presentation, due to excessive noise from the projector or from the cooling fan used with still projectors. In this case the speech level must override the noise as heard at the seats closest to the projector, which may result in uncomfortably high or even distorted levels of reproduced sound, or a strain on the voice of the teacher, as the case may be. The most effective remedy for this situation, aside from providing an absorbent lined housing for the projector or obtaining a quieter one, is to move the seats as far from the projector as possible. This will be more effective if the room is acoustically treated, so as to minimize the spread of noise through the room by reflection.

The only adverse effects of room reflection on speech intelligibility in the average classroom are due to reverberation, which is the prolongation of sounds caused by the continued travel of sound waves back and forth from one room surface to another. If all of the room surfaces are highly reflective, there will be only a small loss of energy at each reflection, and a sound will remain audible for several seconds after its source is stopped. This condition is termed excessive reverberation and has the effect of blurring and overlapping the successive syllables of speech and reducing their intelligibility. The same prolongation takes place with noises which may be created in the room, such as coughing or shuffling of feet, or which may enter from the outside, and magnifies their interfering and distracting effects. By making some of the room surfaces sound absorptive instead of reflective, the sound waves on the average will lose energy more rapidly and individual sounds will die out more quickly, with resulting improvement in speech intelligibility and lessened interference from noise.

The number of seconds required for a standard sound to die out to inaudibility is termed the "reverberation time" of a given room and can be calculated from the room dimensions

and the areas and known absorption coefficients of each of the room surfaces. The sound absorption provided by furniture and occupants must also be included. The effect of introducing acoustical material in reducing the reverberation time is measured by the product of the area of the material and its absorption coefficient. For example, 1,000 square feet of acoustical material with a coefficient of 0.40 will have the same effect in a room as 500 square feet of material with a coefficient of 0.80.

The effect of reducing the reverberation time on speech intelligibility has been measured and it has been found that, in a room of the size of the average classroom, intelligibility is entirely satisfactory for any value of reverberation time below about 1.5 seconds, assuming the speech level and noise level are at acceptable values. The range of reverberation times generally recommended for classrooms is 0.7 to 1.0 seconds. The fact that speech intelligibility does not depend critically on reverberation time within a comparatively wide range of values in a small room has resulted in correspondingly wide divergence in recommendations for the proper amount of acoustical treatment for classrooms.

One well-known firm of acoustical consultants takes the position that reverberation times near the top of the range provide a more comfortable acoustical environment for the teacher and require less expenditure of voice power. Their recommendations generally call for treatment in a band around the perimeter of the ceiling with the center area left reflective. The more usual practice of treating the entire ceiling provides somewhat more absorption than the minimum required for speech intelligibility and is commonly recommended for the purpose of providing some additional noise control, which, in the lower grades at least, may well represent a more comfortable environment for the teacher than a more live and responsive room. The perimeter treatment also introduces the structural problem in new buildings of finishing the reflective area. This usually involves the addition of a finish coat of plaster, or it may be handled by the application of special non-absorptive tile to match the pattern of the acoustical tile. Another possibility is to provide translucent lighting in the center panel.

As a general recommendation, it may be stated that treatment of the entire ceiling of the average classroom with a material having a noise reduction coefficient of 0.70 is the maximum amount of absorption required for either satisfactory speech intelligibility or adequate noise control, and that half of this amount, either in area or efficiency of treatment, will still provide acceptable hearing conditions but with somewhat less noise control. The question sometimes arises as to whether more absorption, in either permanent or temporary form, is required for reproduced sound than for natural speech. There is no evidence, on the basis of either theory or experience, that this is true. In general, if a classroom is properly treated for natural speech communication, it will be equally satisfactory for any reproduced speech or music, whether from motion pictures, recordings, radio, or the school intercommunication system.

Auditorium

Next in importance in the consideration of the control of wanted sound is the auditorium. The wide diversity of programs for which an auditorium is used and the varying conditions under which they are presented require careful attention to the acoustical design of the room. Since complete discussions of this subject are available from many sources, only the essential requirements will be pointed out here. As in the case of the classroom, intelligibility of speech depends both on adequate loudness and on freedom from excessive reverberation. It is almost standard practice to provide speech amplification facilities in all but the smallest auditoriums, so that there is no limitation on loudness under conditions where a microphone can be used. In the case of natural speech, as in dramatic performances, the average loudness as heard by the audience depends of course on the voice power of the person speaking and also on the size and shape of the room. Some of the features of room design which will assist in projecting the available voice energy most efficiently to the audience are (1) avoidance of excessive room volume in relation to seating capacity, (2) well sloped seating areas to provide direct "sound lines," (3) fan shaped plans which avoid wide seating angles at the front and excessively long distances to the rear

seats, (4) shallow under-balcony spaces with high openings, and (5) ceiling and side wall contours which slope upward and outward from the stage opening and are shaped so as to reflect sound waves to the audience with path lengths as close as possible to the direct sound. (See Figure 4.) This general

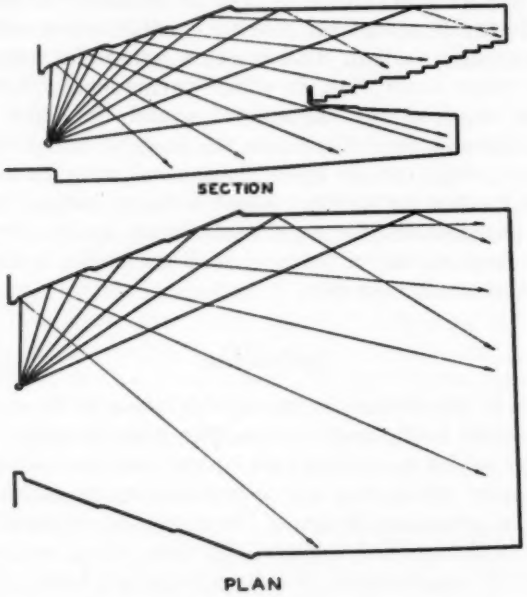

Figure 4
Auditorium Designed to Provide Useful Reflection of Sound to Audience

type of design will also tend to project sound with greater clarity and a quality termed "presence," which denotes the auditory impression of the sound from the stage being close at hand. These effects can be most readily achieved in auditoriums of moderate size. In very large rooms the results of special shaping become less apparent, and more dependence must be placed on projection by loudspeakers.

Auditoriums are used for musical performances of many types, which may often include community orchestral and choral concerts by nationally known organizations. Since reverberation times for the best hearing conditions for music are somewhat higher than for speech, a suitable compromise

is chosen in determining the necessary amount of acoustical treatment. The recommendations of the Acoustical Materials Association[5] concerning acceptable reverberation times for rooms of varying sizes and functions are shown in Figure 5.

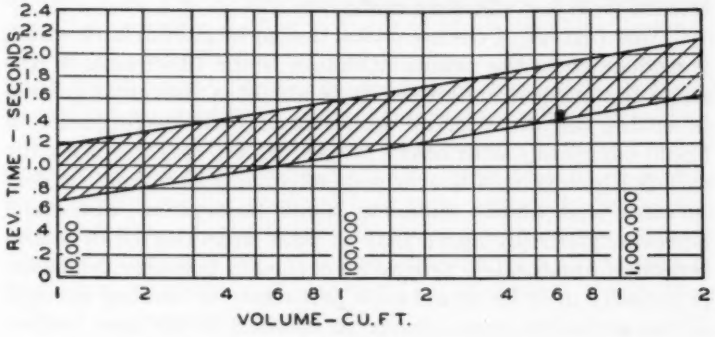

Figure 5

Range of Acceptable Reverberation Times at Frequency of 500 cps for Auditoriums of Various Sizes. Upper Part of the Band Is Most Favorable for Music, and the Lower Part for Speech

The lower part of the band is recommended for speech, the upper part for music, and the center for general purpose rooms, of which the school auditorium is a perfect example. It is necessary also to allow for changes in reverberation time with varying sizes of audience, and particularly to avoid a situation in which hearing conditions are satisfactory for large audiences but reverberation becomes excessive when the room is nearly empty, as for rehearsals. This can be most effectively handled by the provision of upholstered seats, which have the fortunate characteristic of providing nearly the same absorption when empty as when occupied.

While the particular method of distributing a given amount of acoustical treatment in an auditorium has comparatively little effect on the reverberation time, it can be advantageously coordinated with the shaping of the room. This is done by placing the required material, insofar as feasible, on only those surfaces which produce no helpful sound reflection to the audience. Rear walls and the front portions of excessively high ceilings and widely spaced side

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[5] *Theory and Use of Architectural Acoustical Materials*, Acoustical Materials Association, New York.

walls would generally be suitable for treatment by this criterion. Ceilings less than about 25 feet high and wall surfaces shaped to provide useful reflection to the audience are preferably left untreated, treated partially in panels or strips, or treated with low efficiency material.

One feature of the acoustical design of auditoriums which is seldom given the proper attention is the furnishing of the stage for musical activities. It is almost a universal custom in setting the stage for an orchestra or band performance to line it completely with heavy drapes, which, together with the fly loft which is usually overhead, effectively surround the performers with almost complete sound absorption. Musicians however, generally agree that at least some degree of sound reflection immediately around an orchestra is highly desirable, principally in order to aid each performer in hearing the rest of the orchestra more clearly in relation to his own instrument, thus enabling him to keep in better time, intonation, and balance with the group. Reflective stage surfaces also tend to project the sound to the audience with greater volume and better blending of the individual instruments or voices. As evidence for this preference, it may be pointed out that the stages of concert halls are invariably finished throughout with reflective rather than absorptive materials. In a school auditorium, reflective surfaces may be provided in the form of movable flats of plywood, hardboard, or even heavily painted insulation board. These should be set behind and at the sides of the orchestra, and overhead if possible. If the rear stage wall is of presentable appearance, it can simply be left exposed in place of reflective flats at the rear. The angles of the flats at the sides and overhead should be arranged so that some of them reflect sound toward the audience and others produce some reflection back to the orchestra. Some schools have provided rather elaborate arrangements of convex cylindrical reflectors which accomplish this very effectively.

Music Rooms

A third general area of the school in which special attention to the acoustical environment is necessary is the music department. The rooms requiring primary consideration with regard to acoustical design and treatment are the band and

orchestra room, the choral room, and the practice rooms. The essential requirements of the ensemble rooms are, first, that the instructor be able to hear the instruments and voices clearly and easily, both individually and in ensemble, and, second, that the acoustical characteristics of the rehearsal room be generally similar to those of the rooms or surroundings in which performances may be given. The latter requirement is, of course, impossible to satisfy completely, because the acoustical conditions at the performances themselves may vary so widely from one place to another. However, most conductors and music instructors will agree that the most adverse conditions for good performance, especially for school pupils who are relatively inexperienced, are in extremely dead rooms or stages, or out of doors, and that, if a group can be trained to perform well under these conditions, it can perform well practically anywhere.

The most favorable conditions for educational purposes are therefore obtained when the rehearsal room is made comparatively dead acoustically. Reverberation times of 0.75 to 1.0 seconds have been generally recommended and, from what limited evidence is available, may be considered acceptable. A recent study at the University of Texas[6] indicated that a one-second reverberation time was possibly a little too high for best hearing conditions in an instrumental room. Efforts to bring the reverberation time much below about ¾ second, however, require large amounts of treatment in the average sized rehearsal room and produce comparatively little improvement in hearing conditions. There is no direct evidence to indicate that instrumental rooms should differ significantly from choral rooms in acoustical characteristics. Location of acoustical treatment is not critical in these rooms. Usually the ceiling is the most convenient area, and is sometimes the only surface large enough to accommodate the required amount of absorption.

The need for sound control in practice rooms is due principally to the fact that sound, when confined in a very small room, builds up to an abnormally high level, particularly when

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[6] Fitzgerald, R. B., and Blankenship, J., *Comparison of Objective and Subjective Observations on Music Rooms*, paper presented at the 48th meeting of the Acoustical Society of America, Austin, Texas, November 19, 1954.

the room surfaces are all reflective. In the University of Texas study referred to above, performers were asked to indicate their preference between practice rooms which were acoustically treated by different amounts so as to produce reverberation times of approximately 0.3, 0.5, and 0.8 seconds. The rooms with the 0.5 second time were rated best by a high margin. In treating very small rooms it is good practice to place acoustical material on two adjacent walls in addition to the ceiling. If a pair of opposite walls is left reflective, the walls being unbroken and parallel, there is a tendency for sound to be reflected back and forth along the same path between these walls, causing an audible flutter or ringing effect which is often distracting and may amount to an actual distortion of musical tones produced in the room. Placing the walls out of parallel will also eliminate this trouble, and is sometimes done for this purpose. Venetian blinds or window drapes also accomplish the same result.

It is sometimes desired to use the rooms in the music department for activities other than their nominal function. For instance, it is often desired to use the rehearsal room for recording or for phonograph or radio reproduction. The range of reverberation times recommended above will in general be suitable for these other uses. It may be found, however, that better results in recording the finished performance of an instrumental or vocal ensemble will be obtained in the auditorium than in the rehearsal room, because of the less restricted choice of microphone placement. The practice rooms may also be used for record listening, for which purpose the above indicated treatment will be found adequate. These rooms will probably be less satisfactory than the rehearsal room for solo recording, because of their small size.

Acoustical Materials

Acoustical materials[7] used in school buildings are almost universally specified in the form of prefabricated integral tiles and boards of cellulose or mineral fiber composition, ranging in size from 12″ x 12″ to 24″ x 48″ and in thickness from ½″ to 1″. The principal advantages of this type of treatment

[7] *Bulletin 15*, Acoustical Materials Association, New York, 1955.

are economy in material cost and erection and adaptability to a number of installation methods. The surfaces of most acoustical tiles are furnished with a washable factory paint finish of high light reflectance and are provided with mechanical perforations or slots, or natural fissures, which allow penetration of sound waves to the porous interior where sound absorption takes place. These surface openings permit the tile to be repainted by standard maintenance methods without loss of sound absorption. They also provide a choice of decorative effect. Two types of perforated surface and a fissured material are illustrated in Figures 6 to 8.

Figure 6

Ceiling of Acoustical Tile with Regular Perforation Pattern. Tile Are Supported by Mechanical Suspension System with Exposed Metal Members. (Darien Junior High School, Darien, Connecticut)

Acoustical tiles may be applied by means of approved adhesives to surfaces of brown or finish plaster, concrete, and gypsum board which are in proper condition. A tile size of 12″ x 24″ is generally the largest that is recommended for adhesive application. All cellulose fiber and some mineral fiber tiles and boards may be nailed or screwed to wood furring on proper spacing, and may also be screwed to a suspended gypsum board backing. The latter method provides an especially flat, level finished ceiling surface. Most tiles and boards may be installed as a complete suspended ceiling by means of metal members which either engage slots in the

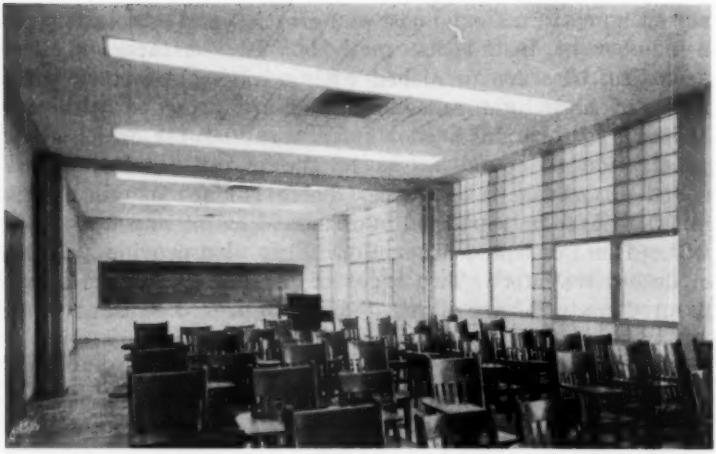

Figure 7
Acoustical Tile Perforated with Random Pattern. (Music Building, Montana State University, Missoula, Montana)

Figure 8
Acoustical Tile with Fissured Surface. (Eastern Heights Elementary School, Elyria, Ohio)

edges of the tile or are exposed. The maximum unsupported span of tile or boards which is allowable depends on the deflection characteristics of the particular material used, especially with respect to high humidities.

A number of mechanical suspension systems are available which permit the combination of sound absorptive ceiling sur-

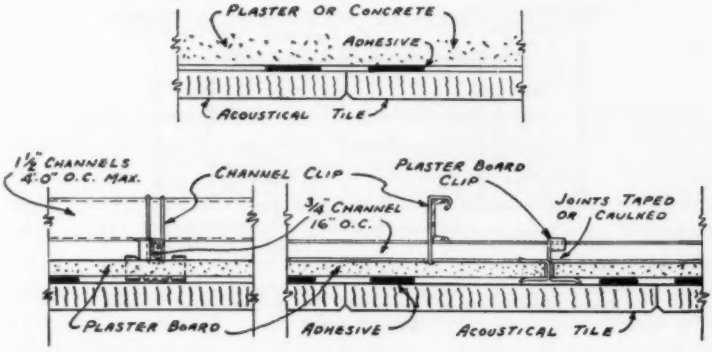

Figure 9
Adhesive Application of Acoustical Tile to Plaster, Concrete, or suspended Gypsum Board

faces with lighting, air conditioning, and sometimes radiant heating elements in any desired arrangement. The systems having exposed suspension members generally provide easier removal of acoustical tile or board from the under side, where access to the space above is desired.

These various erection methods are illustrated in Figures 9 to 12.

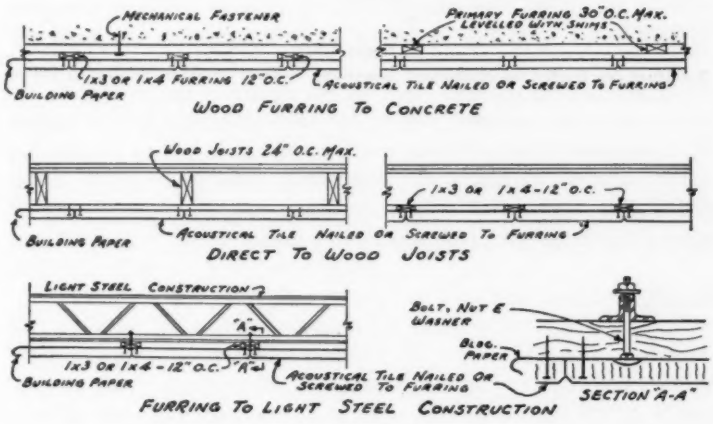

Figure 10
Erection of Acoustical Tile by Nailing or Screwing to Wood Furring

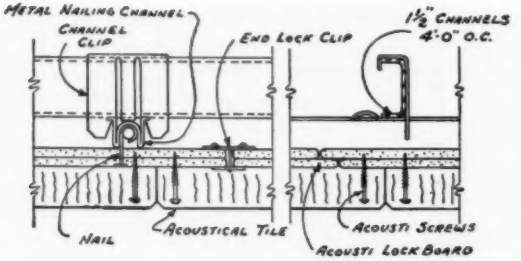

Figure 11
Screw Application of Acoustical Tile to Suspended Double Gypsum Board

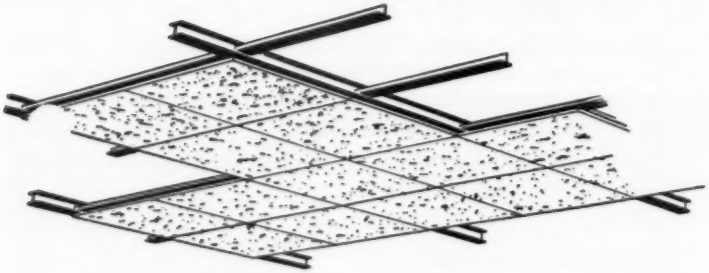

Figure 12
Acoustical Tile Erected by Mechanical Suspension to Form Complete Suspended Ceiling

BALANCING THE THERMAL ENVIRONMENT FOR AUDIO-VISUAL EDUCATION

Zephyrin A. Marsh

In every aspect of life, no matter where our interests lie, we are continually aware of change and progress. Everywhere we look we see evolution from the old to the new, from the good to the better. Nowhere is this evolution more apparent than in the concept and design of our public schools. We have come a long way toward making the school building and the school curriculum such that education can be enjoyed and looked forward to. This progress must be continued if our school systems are going to keep pace with the age in which we live, where the trend in all phases of our life is one toward being able to do things easier, better, faster, and with less effort.

Everywhere you find continued, steady progress. We find leaders who have objectives they are continually keeping in mind and driving toward. In planning school buildings, we must also have objectives that are valid and sound if we are going to continue our progress toward improvement. I think the one objective that we can all agree upon is *A BETTER EDUCATION FOR OUR CHILDREN.*

I feel this objective is very valid. Our greatest natural resource in this country is the people, and the value of this resource can be measured in terms of the level of education that the people acquire.

Why, in our country, do we have the highest standard of living in the world today? It is not because we have more people. It is not because we have more natural resources. It is not because we have more land. It is simply because, early in the history of our country, public education was made available, not to the chosen few, but to every member of our society. This we must continue!

But it is not enough just to say that our children should be in school for a given number of days or for a given number of months or for a given number of years. We must continually improve the amount of education that our children receive during the time they are in school. Whenever we find a school

system that is not progressing toward providing a better education for the children in that community, we will find that someone in leadership has lost sight of the real objective and is working toward some compromised objective. We have all heard many of the compromise goals—"to get a roof over their heads," "to raise the tax base," "to get more teachers," "to lower the cost of construction." Each and every one of them may be valid, but they are valid only if they are in keeping with our main objective, and that is to get *A BETTER EDUCATION FOR OUR CHILDREN*. We must continually keep this primary end in mind if we are going to improve the effectiveness of our schools.

It may be true that in some cases we have to make compromises. But again, if we have the over-all objective, the basic and valid objective of better education for our children, in mind, we will compromise on the points that are less essential to the child's ability to learn than on those that will hinder his progress in school. All too often we find an apathetic willingness to compromise, even to the extent that we cut the heart out of our educational program. This we must avoid at all costs.

What is our basic problem? Our basic problem is that we are having to conduct classes in schools that are not as well equipped as we know they should be to carry on a good modern-day educational program. And what is more, even today new schools are being constructed that are not taking into consideration the available know-how that we have on the need for school facilities.

What are the causes of the problem? I think they are quite simple:

1. We have architects who are interested in selling their services and, as such, they must get visibility to some aspect of a school building that they think will make a better school. In some cases, they use gimmicks and crutches. When we hear an architect say, "I can build a school building for less money than anyone else," he is using a gimmick to sell his services and he should be made aware of the basic purpose and objective in education today. Price can not be the only objective. We must be able to use the building as an educational plant.

2. We are not getting dramatic visibility to the school building facilities that are needed for modern day curriculum,

such as light control, glare control, and temperature control, just to mention a few.

3. (And this comes very closely to being a part of number two.) Educators are doing a wonderful job of educating children. They are spending all of their time educating children. This sounds valid, but falls down when we find that the same educators are not doing everything they can to educate the architect. Architects, by and large, are honest, sincere, conscientious people, and they will only build a school that falls short of the needs of education if the needs of education are withheld from them; if the people in education, who know what educational facilities are needed, do not make these needs known to the architect.

The situation becomes pathetic when we find that the teachers going through our teachers colleges today are being taught the use of all of the audio-visual facilities that can be used to enrich the curriculum. They are taught the usage and the purposes of them, and then, when they go into the classroom, they find they do not have the building facilities required to carry on and make use of the know-how they received while in college. In industry we would never send our employees to school to teach them all about the advanced tools of modern-day production and then put them on an assembly line with a pair of pliers and a screwdriver and expect them to perform as well as they could if they had the machines they were taught to use. It would be like the Air Force training their pilots in the use of the finest navigational aids that are available today, and then not equipping the airplanes that these pilots are going to fly with these same instruments.

The point is this: If educators are going to be able to use audio-visual material and other tools available to them to provide children with a better education, they must have the proper environment in which to accomplish this. Without the proper environment, much of the effectiveness of these modern teaching materials is lost.

I think we must make two basic assumptions: (1) that visual materials do enrich the curriculum, and (2) that the majority of architects are sincerely interested in providing the best possible learning facilities.

As far as the thermal aspects of a school building are concerned, I would like to tell you about an incident that happened in my family in April. My daughter, Rosalie, received her driver's license last fall and has been driving sporadically every since, every time she can talk the old man out of the car. And she has become quite adept at being able to steer the family automobile around all the obstacles that are on our streets today. But there was something that was missing in her education as far as operating an automobile was concerned.

On this particular occasion, Rosalie had the car on Sunday afternoon and, after having been gone for about three hours, came walking home to tell me that the car would not run any more. On checking, I found that the automobile was out of water and out of oil, and that the engine was completely frozen. Apparently the water had become low and the temperature of the engine had begun to rise. And, inasmuch as the temperature gauge on the dash was obviously still working, it had indicated that the temperature was too high. But Rosalie had completely ignored this warning. I would assume that the next warning signal that occurred was that the oil pressure dropped, but again this warning was ignored. I imagine that there was a third warning—noises developing in the engine before it completely quit, water boiling, the main bearings and connecting rod bearings being completely ruined, and the valves being broken. Yes, I imagine that there were some fairly loud noises, but these, too, were ignored. As long as the engine was capable of developing horsepower and carrying the automobile along, it was urged on until it became so overheated that it finally was unable to go any farther.

Now would it not have been nice if there had been some mechanism built into this automobile so that, as the temperature became excessive, the power input would slow down to prevent the engine from literally killing itself off, so that, as the engine became overheated, as it was unable to dissipate the excess heat it was producing, it would just slow down and stop before the heat was so excessive that the engine was completely ruined? Obviously, if there had been such a mechanism the engine would have stopped, and at that time Rosalie would have come home and again stated that it would not run. But then all I would have had to do was to put more oil and

more water into it. In other words, I would merely have had to restore the engine's ability to dissipate the heat that it was producing, and there would have been no damage done.

When we are driving our automobiles, we are expected to be this mechanism. We are expected to cut down the heat input when the automobile engine has lost its ability to dissipate the amount of heat the engine is producing. As far as the human body is concerned, we do have such a mechanism built into us, so that as we are less able to dissipate the excess heat, the heat production is slowed down. This happens without our really being aware of it. It happens in children. It happens in adults. If we are in an environment where we are unable to dissipate any more heat, we just slow down to the point where there is no more excess heat being produced, until we are once again able to dissipate it. This actually is a very wonderful mechanism, which is responsible for each and everyone here today being alive and in good health. Regardless of the activity in which we are engaged, regardless of the importance of it, we do not want to continue manufacturing heat at a rate that would destroy the tissues of our body. We can replace the engine in an automobile, but this procedure is not so simple in the human body.

As I said, this wonderful mechanism serves a very useful purpose. Let us look at what we must do to recognize the importance of this mechanism. It is obvious that in any work situation, when the temperature in the area rises to such an extent that we can not dissipate the optimum amount of heat, the normal action of the body is to slow down its process. The amount of work we produce is less. This again has to be, if we are to survive. When we realize this basic mechanism and its effect on our ability to produce, our ability to concentrate, our ability to work, then we must realize how important it is that we maintain the proper temperature conditions around the body if we are interested in getting maximum productivity.

Now do you suppose we should criticize children for not being alert, for not being attentive, and for not doing their work in school when the temperature in the classroom is high? When we criticize them, we are criticizing a basic natural phenomenon that occurs within the body, one that is designed to preserve the body under adverse conditions. It is one of

the wonderful adapters built into each and every one of us. We should not expect children to respond as quickly under adverse conditions as they could and would respond under better conditions.

What we are doing, actually, when we permit high temperature conditions to exist in the classrooms, in our office, and in our factories, is to deliberately slow down the end result of what the people are there to accomplish.

We build a school building for one reason only—to get a better education for the children who attend the school. Does it not make sense, then, that we should plan the school's facilities so as to provide means for the children to participate to the maximum with their full ability and motivation? Should we not recognize the fact that, even though children can adapt to poor temperature conditions, they are going to pay dearly for that adaptation in terms of slowing down their reactions, their alertness, their ability to think and to do the job at hand?

Industry and business have long recognized this fact, and therefore, when modern office buildings, hotels, restaurants, theaters, yes, even night clubs, are built, they are equipped with air conditioning. Air conditioning is the means of maintaining a temperature level in a certain area that will permit people within that area to react at the optimum level without damaging the body tissues in doing so.

If this is true, and we all know that it is, should we not recognize the same need when we are designing, when we are planning, when we are building better school buildings? Is it not just as important when we use our dollars efficiently and effectively on school construction as it is when we spend dollars in creating any other type of building? I do not really believe that any of us who have the responsibility of school planning, school designing, and school construction are discharging our responsibilities fully if, in building schools, we are deliberately cutting down the efficiency and effectiveness of the students who will use them.

Whether it be an existing building or a new building, it is important that we provide the facilities to keep the temperatures within a range that will permit the students to dissipate the heat that the body must produce to maintain normal activity levels.

The technical "know-how" and the technical equipment for creating the proper environment in schools is readily available. What is still lacking, perhaps, is the awareness of the real value to teaching of this equipment in the process of teaching.

The state of Indiana has demonstrated leadership in the past in many phases of education. Today there is a definite opportunity for this state to again demonstrate such leadership. I would like to predict that soon we will see schools as completely air conditioned as the other buildings in our communities now are. But this is not going to come about until everyone involved in the planning, construction, and maintenance of school facilities becomes fully aware of the real purpose of the educational plant. The real objective of education is that of providing the most education possible for our children.

BULLETINS IN THE FIELD OF EDUCATION INDIANA UNIVERSITY

The *Bulletin of the School of Education*, Indiana University, was first published in 1924 and has appeared regularly since that time. A complete list of the bulletins may be obtained from the School of Education upon request. The studies included in the present and in the two volumes immediately preceding it in date are listed below. Unless otherwise indicated, these may be obtained for $1 each from the Indiana University Bookstore, Bloomington, Indiana.

The Local School Facilities Survey, by Harold H. Church, Paul W. Seagers, W. Monfort Barr, William H. Fox, and Maurice E. Stapley, Vol. XXIX, Nos. 1 and 2, 1953, 96 p.

The Tenure of Indiana School Administrators, by Raleigh W. Holmstedt, Vol. XXIX, No. 3, 1953, 36 p.

A Guide to the Source Materials Relating to Education in the Laws of the State of Indiana 1816-1851. Part One: 1816-1838, by Velorus Martz and Stanley E. Ballinger, Vol. XXIX, No. 4, 1953, 96 p.

An Experimental Analysis of Patterns of Differential Verbal Reinforcements in Classroom Situations, by Edmund V. Mech, Francis M. Hurst, J. Donavon Auble, and Nicholas A. Fattu, Vol. XXIX, No. 5, 1953, 25 p.

Indiana and Midwest School Building Planning Conference: Proceedings, Vol. XXIX, No. 6, 1953, 104 p.

Use of Evaluative Criteria in the Indiana Secondary Schools, by Carl G. F. Franzén, Christian Jung, and Otto Hughes, Vol. 30, No. 1, 1954, 83 p.

The Organization of the School of Education, Indiana University, for Policy Development, by A. Stafford Clayton, Vol. 30, No. 2, 1954, 43 p.

An Analysis of the Current Expenditures of Selected Indiana High Schools, by W. Monfort Barr, Vol. 30, No. 3, 1954, 30 p.

Promising Curriculum Practices in Secondary Schools in Indiana, by Indiana Association of Secondary School Principals—Editors: Carl G. F. Franzén, Arthur Hoppe, and Donald L. Simon, Vol. 30, No. 4, 1954, 98 p.

Indiana and Midwest School Building Planning Conference: Proceedings, Vol. 30, Nos. 5 and 6, 1954, 123 p. $2.

A Brief History and Analysis of the Operation of the Educational Placement Service at Indiana University, by August William Eberle, Vol. 31, No. 1, 1955, 30 p.

An Approach to the Study of Motivational Problems in Education, by William W. Lynch, Jr., Vol. 31, No. 2, 1955, 48 p.

Proceedings of the Third Statewide Conference on the Fifth Year in Teacher Education, Vol. 31, No. 3, 1955, 69 p.

Present Practices and Trends in the Preparation of Elementary School Principals at the Graduate Level, by Carlos M. Watson and Robert W. Richey, Vol. 31, No. 4, 1955, 54 p.

Indiana and Midwest School Building Planning Conference: Proceedings, Vol. 31, No. 5, 1955, 149 p.

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